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During the period 8 June to 24 July 1987, a study was conducted in the laboratories of the Materiel Systems Human Factors Branch at U.S. Army Natick RD&E Center. The research examined the relationship between personality factors and the effects of microencapsulation in Mission Oriented Protective Posture level 4 (MOPP4) gear on performance and anxiety level. Acclimatization to the anxiety producing effects of MOPP4 was also investigated. For comparison purposes, subjects performed tasks and filled out questionnaires in both a Battle Dress Uniform (BDU) condition and a MOPP4 condition. For each of the 12 volunteer military subjects, measures of subjective trait and state anxiety, self-reported personality traits, and various (cont.)

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sensorimotor and cognitive performance measures were gathered during a 10-day test phase consisting of two 5-day periods separated by a 9-day recovery period. We found that personality factors, state and trait anxiety, and measures of sensorimotor and cognitive performance were related to each other in complex ways and to microencapsulation in MOPP gear. On the first day of donning MOPP4, subjects' state anxiety increased significantly. Over the course of five daily sessions of wearing MOPP4, the level of state anxiety decreased so that by the fifth day, the subjects no longer showed elevated state anxiety. Subjects who reported high levels of anxiety before or after the daily test period also reported characteristics associated with introversion, as measured by the Sixteen Personality Factor Questionnaire (16PF). In contrast, subjects who reported low anxiety before or after the daily test period reported characteristics associated with extraversion. In addition, subjects who performed better on a balance beam task or correctly identified more visual stimuli on a tachistoscope task tended to report characteristics of independence, as measured by the 16PF.

PREFACE

During the period 8 June to 24 July 1987, laboratory studies were conducted in the Material Systems Human Factors Branch at the U.S. Army Natick RD&E Center. The studies were part of work unit #DA303742 under project #1L161102AH52 "Sensory and Psychological Adaptation During Encapsulation." For comparison purposes, soldiers were tested under conditions of the nonrestrictive Battle Dress Uniform (BDU) and of the encapsulating Mission Oriented Protective Posture (MOPP). The present report describes the results of this laboratory study.

The authors would like to acknowledge the help of the military volunteers who participated as subjects in this study. Also, the authors would like to acknowledge Larry Lesher, Karen Wittbrodt, Erik Dragsbaek, Robert Rando, and Connie Miles for their contributions in the collection and analyses of data, Heather Dragsbaek for her computer programming of the vigilance task and the memory and search task (MAST), and Armand Cardello, Owen Maller, and Lawrence Symington for their reviews of the report.

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THE EFFECTS OF MICROENCAPSULATION ON SENSORIMOTOR AND COGNITIVE PERFORMANCE: RELATIONSHIP TO PERSONALITY CHARACTERISTICS AND ANXIETY

INTRODUCTION

While the United States has a policy against the use of chemical or biological weapons, it is advisable to prepare soldiers to carry out their missions in a contaminated battlefield.[1] Currently, soldiers are exposed to various training exercises while dressed in chemical protective clothing. Although this type of training is crucial in preparing for the contaminated battlefield, there is also a need to understand how and why chemical protective clothing can affect the performance of soldiers.

Mission-oriented protective posture (MOPP) gear is a full body clothing system, which protects the soldier from a variety of chemical and biological threats. The gear consists of an overgarment coat and trousers, overboots, a mask with hood, and gloves with liners. This protective equipment is worn in the event or threat of a chemical or biological attack. Various components are donned or doffed according to the degree of risk of contamination. The levels of MOPP gear and the associated items worn are presented in Appendix A.[2] This equipment totally encapsulates the soldier and, largely because of this, it has several deleterious effects on the fitness of the soldier to carry out his mission. Most notably, wearing chemical protective gear significantly increases the chances that a soldier will become a heat stress casualty.[3,4] The physiological effects have been studied extensively and countermeasures, such as microclimate cooling, are being developed.[5-8]

Encapsulation in MOPP is also associated with various behavioral/psychological effects.[9-14] Undoubtedly the

restricted sensory input and the confinement in MOPP gear contributes to the increased anxiety, hyperventilation, and, occasionally, panic reported by soldiers during field tests.[15-17] Further, there is specific evidence that MOPP gear degrades vision, tactile sensitivity, and balance.[9,11] As a consequence, other performance deficits can occur. For example, soldiers can find it more difficult to communicate, to operate certain pieces of equipment, and to perform other mission-related tasks. It should be noted that many of the challenges the soldier faces while wearing MOPP gear are faced by others who wear similar protective equipment. Firefighters, divers, and astronauts, among others, must wear equipment which saves their lives but reduces their performance.

None of the degrading effects of MOPP gear are static. That is, these effects develop over time and only become significant after an extended period under certain conditions. While this is true in the single mission scenario, the question can be asked about what happens when soldiers wear encapsulating chemical protective equipment for relatively brief periods for several days. Will such experience lead to a resistence to some of the degrading effects of encapsulating clothing? There is some observational evidence from field studies that subjects with experience in MOPP gear are less adversely affected by wearing such chemical protective clothing compared to those without experience.[13,18] Therefore, in the present research we were interested in determining if soldiers would exhibit systematic acclimitization to deficits associated with wearing MOPP gear.

State anxiety as measured by the State-Trait Anxiety Inventory (STAI) is described by Spielberger, Gorsuch, & Lushene,*[19] as being a measure of an individual's level of anxiety during a specific situation. Trait anxiety on the other

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hand, is described as being a stable characteristic and is considered to be a measure of an individual's proneness to elevated state anxiety. Previous work in our laboratory indicates that state anxiety is significantly increased in MOPP gear and might be susceptable to acclimatization.[20,21] It was these results related to state anxiety combined with the work of others who have found relationships between encapsulation in MOPP gear and performance, that led to the current investigation. Past research suggests that certain personality characteristics, including trait anxiety, may be useful in identifying soldiers who would be less likely to perform well if they are exposed to chemical agents.

The investigation of the relationship between personality characteristics and performance has taken many forms. NASA's research efforts have included the use of personality characteristics or traits in developing criteria for the selection of astronauts for long-duration space missions.[22,23] In an Army field study where soldiers were dressed in chemical protective clothing, Arima[24] revealed consistent relationships between personality traits measured by the Minnesota Multiphasic Personality Inventory and whether or not individuals dropped out of the study. Arima suggests that certain types of individuals will be more susceptible to the combined stresses of performing in a chemically contaminated environment and combat.

In a more recent study by Rauch, Banderet, Tharion, Munro, Lussier, and Shukitt[14], a Personality Assessment Battery developed by the United States Army Research Institute of Environmental Medicine (USARIEM) Natick, MA, was administered. Rauch et al. discovered significant differences between "casualties" and "survivors" involved in a sustained artillery operation while dressed in MOPP4. In summary, casualties reported tiring more quickly, perceived their duty to be less stressful, and volunteered for the study because of the challenge. In a subsequent study by Tharion, Rauch, Munro,

Lussier, Banderet, and Shukitt[13], the same Personality Assessment Battery was administered. Those researchers found differences between "casualties" and "survivors" dressed in MOPP4 who were involved in an armor field test. Casualties reported more depressive tendencies and a lower self-motivation than survivors. The outcomes of these two field tests demonstrate the feasibility of using personality characteristics in relationship to classifying soldiers as potential casualties or survivors.

It is evident in the scientific literature that personality characteristics play an important role in the performance of soldiers dressed in chemical protective clothing. The goal of researchers, then, is to determine which personality measurement tool yields consistent results about the relationship between personality and the performance of soldiers dressed in MOPP. In the present study, it is hypothesized that personality traits as measured by the Sixteen Personality Factor Questionniare (16 PF) will be related to a prescribed battery of laboratory performance measures.

METHOD & RESULTS

Subjects

Thirteen male soldiers specializing as field engineers volunteered to participate in a study to evaluate the effects of wearing MOPP4 gear (see Appendix B). One soldier dropped out after week one, therefore, his data are not included. All subjects filled out a subject comparison survey, from which the following information was obtained. The mean age of the subjects was 21 years (range 18 to 25). All subjects had worn MOPP gear within the last six months, with 11 having worn MOPP at level 4. Five of the 12 soldiers were involved in a regular exercise program, and six soldiers smoked cigarettes regularly. Prior to testing all subjects were briefed about the nature, duration, and risks of the tests and signed a volunteer agreement of informed consent (see Appendix C).

General Design

A two factor, within-subjects design was employed. This basic design included type of uniform (BDU or MOPP4) and day (1 through 5) as the independent variables. The various measures taken during the 10 test days however required variations and additions to the basic experimental design. Therefore, following the General Procedure subsection, separate Procedure and Results subsections are included for each task.

General Procedure

For each subject, data were collected on 10 test days, which consisted of two Monday through Friday time periods. There was a nine-day recovery period between the two test periods. During the first five-day period, subjects were in either the BDU or the MOPP4 uniform condition. In the BDU condition, subjects wore BDUs on the first four days and MOPP4 gear over their BDUs on the fifth day (Friday). In the MOPP4 condition, subjects

wore MOPP4 gear over their BDUs for all five days. For the second five-day period, uniform condition was reversed: those subjects initially assigned to the MOPP4 condition were assigned to the BDU condition, and those subjects initially assigned to the BDU condition were assigned to the MOPP4 condition. The assignment of uniform condition was counterbalanced, so that six subjects were in the BDU condition first and six subjects were in the MOPP4 condition first.

Data were collected during three successive 10-day phases consisting of two Monday through Friday time periods. Five subjects participated in the first phase (three had the BDU condition first and two had the MOPP4 condition first), four subjects participated in the second phase (all had the MOPP4 condition first), and three subjects completed the third phase (all had the BDU condition first).

Subjects were tested for approximately three hours on each of the 10 test days. Those subjects who wore MOPP4 took off the face mask for 10 min every hour. During the three hour blocks, a variety of tasks were administered, some on a daily basis and some for fewer times per week. One task, the memory and search task (MAST), was administered for pilot work, therefore, the data collected are not included in this report. A weekly schedule of the tasks is presented in Figure 1. Testing took place in a suite of four rooms, which was divided into five testing stations. Mean temperature during testing was 70°F (22°C). All tests were conducted under normal room illumination (30-70 ft-L), which was measured using a Sekonic Auto-Lumi L-158 light meter.

Most of the tasks were administered on a rotating basis so that each subject was tested individually. On all test days except for Thursdays, the three hour time block was divided into nine segments. The division included: one 30-minute segment for the administration of a state anxiety test and uniform preparation, five 20-minute segments for administration of the tasks, two 10-minute segments for resting, and one 30-minute

segment for the second administration of the state anxiety test and uniform removal. After the initial 30-minute segment, subjects were randomly assigned to their first task station. Some of the tasks did not require the full 20 minutes to complete. Under these circumstances, subjects were provided with a variety of items to occupy them (newspapers, magazines, and computer games) or they could sit quietly while waiting to move to the next station. Every 20-minutes the subjects moved to the next successive station, until the tasks at all five stations were completed. Those who were dressed in MOPP4 gear took their suits off and prepared their masks for the next test day.

WEEKLY TASK SCHEDULE*

TIME	DAY1 MONDAY	DAY2 TUESDAY	DAY3 WEDNESDAY	DAY4 THURSDAY	DAY5 FRIDAY
800	Trait Anxiety	State Anxiety	State Anxiety	State Anxiety	State Anxiety
805	State Anxiety			16PF	
810	Uniform Preparation	Uniform Preparation	Uniform Preparation		Uniform Preparation
815					
820					
825					
830	Station #1	Station #1	Station #1		Station #1
835					
840					
845					
850	Station #2	Station #2	Station #2		Station #2
855					
900				Uniform Preparation	
905					10 minute rest
910	10 minute rest	10 minute rest	10 minute rest	Station #1	
915					Station #3
920	Station #3	Station #3	Station #3		
925				Station #2	
930					
935					Station #4
940	Station #4	Station #4	Station #4	Station #3	
945					
950					
955					
1000	10 minute rest	10 minute rest	10 minute rest	10 minute rest	10 minute rest
1005					
1010	Station #5	Station #5	Station #5	Station #4	Station #5
1015					
1020				Station #5	
1025					State Anxiety
1030	State Anxiety	State Anxiety	State Anxiety		
1035				State Anxiety	Uniform Removal
1040	Uniform Removal	Uniform Removal	Uniform Removal	Uniform Removal	and Cleaning
1050	and Cleaning	and Cleaning	and Cleaning	and cleaning	
1055					
1100					

Task	Days Administered
Tachistoscope	1 and 5
Balance Beam	1, 2, 3, 4 and 5
Vigilance	1, 2, 3, 4 and 5
Stroop Test	1 and 5
Embedded Figures Test	2 and 4
Contrast Sensitivity	3
Mast Test	1, 2, 3, 4 and 5
Demographic Survey	2
Wait Station	3 and 4

*Week #2 was identical to Week #1 with the exceptions of Monday, Tuesday and Thursday. The Trait Anxiety Test was not given on the second Monday. The Demographic Survey was not given on the second Tuesday, it was substituted with a wait station. The 16 PF Personality Test was not given on the second Thursday, which allowed more time for the tasks and an additional rest period.

Figure 1. Weekly task schedule.

The exceptions to this general time schedule were Thursdays. On the first Thursday of each 10-day test phase, the three-hour time block was divided differently than the other test days. There were 10 segments of time: a 10-minute segment for administration of the state anxiety test, a one-hour time segment for the administration of the 16 Personality Factor Questionnaire (16 PF), a 10-minute segment for uniform preparation, five 15-minute segments for completion of other tasks, a single 10-minute break, and a final 15-minute segment for measuring state anxiety and removal of uniforms for those wearing MOPP4 gear. It should also be noted that one of the five task stations was actually a wait station with no task assigned. On the second Thursday of each 10-day test phase, the three-hour time block was divided the same as the other eight test days with the exception that one of the task stations was a wait station.

The data gathered in the study were analyzed using the statistical software packages SPSS/PC+ and BMDP.[25-28] Statistical procedures such as multivariate analysis of variance (MANOVA), correlations, and regressions were employed. Post hoc analyses in the form of the Newman-Keuls test and individual comparisons were performed using Winer[29].

State-Trait Anxiety Inventory

Materials

The State-Trait Anxiety Inventory (STAI)*[19] was used to measure subjective anxiety levels. The trait anxiety (A-Trait) portion of the inventory is designed to measure an individual's tendency to respond to psychological stress with an increase in state anxiety. The state anxiety (A-State) portion of the inventory is designed to measure an individual's transitory

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state-dependent anxiety. Trait anxiety is assumed to be stable over time, while state anxiety varies considerably depending on the situation. In the present study, the A-Trait scale was used as a measure of the subjects' general level of anxiety and the A-State scale was used as a measure of the subjects' anxiety at the beginning and the end of each test day.

The STAI questionnaires consist of 20 questions each. A score on each question can range from 1 to 4, with a higher score corresponding to higher trait or state anxiety. Consequently, total scores can range from a low of 20 to a high of 80.

Procedure

The A-Trait Anxiety Inventory was given only one time, on the first test day before the administration of any other test. Prior to administration of the A-Trait, subjects were instructed to answer questions on the form according to "how you generally feel". On each test day, the A-State Anxiety Inventory was given to the subjects before uniform preparation, after which they participated in the tasks. Prior to administration of the A-State, subjects were instructed to answer the questions on the form according to "how you feel at this particular time, right now". Upon completion of the A-State form, those scheduled to wear MOPP4 donned the chemical protection equipment. During the next two hours the subjects completed the scheduled tasks. Subjects then filled out the A-State Anxiety Inventory again. All subjects filled out their forms separately and privately.

Results

The average trait anxiety score for the group was $\underline{M}$ = 34.9 ($\underline{SD}$ = 8.78), which was used for correlational purposes later in the report. The subjects' state anxiety pretest scores were subtracted from the state anxiety posttest scores to determine difference state anxiety scores, which were used in the following analyses. Mean scores for each uniform condition and day are presented in Figure 2.

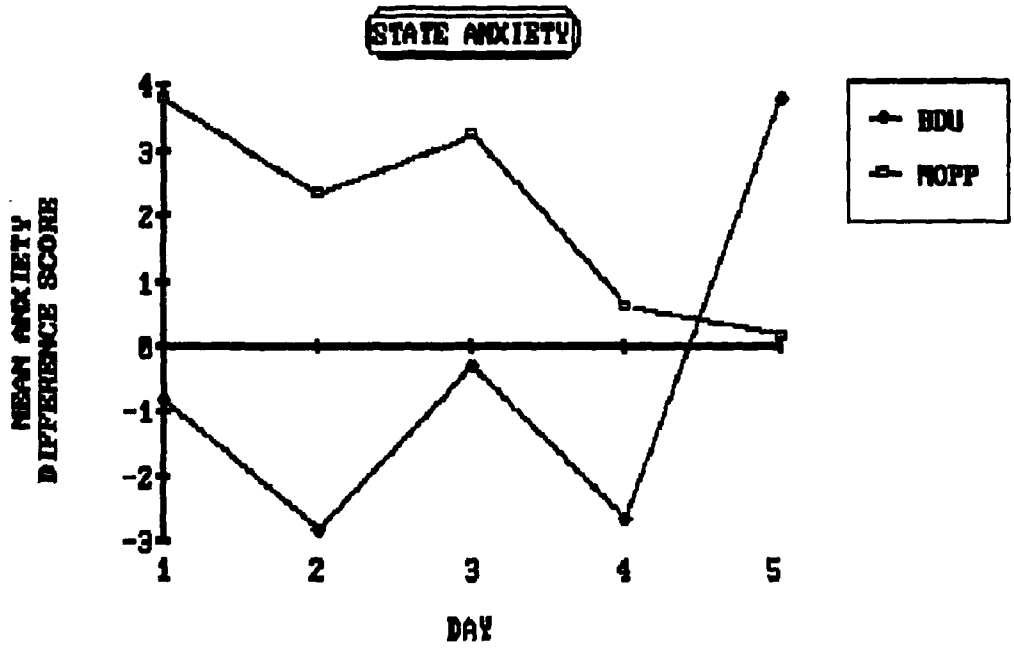

Figure 2. Mean state anxiety difference scores as a function of day.

A MANOVA performed on the data from day one through day four indicated that subjects were significantly more anxious while wearing MOPP4 than while wearing BDU during the two hour testing period ($F(1,10) = 6.87$, $p = .026$; see Figure 2). A MANOVA on data including day one through day five revealed a significant day by uniform interaction. Due to the significance of the Mauchly sphericity test ($W = .153$, $p = .07$), the degrees of freedom were corrected with the Huynh-Feldt Epsilon (.7911). Individual comparison tests of the interaction ($F(3.2,32) = 2.85$, $p < .05$) revealed that anxiety increased significantly on day two while wearing the MOPP4 uniform compared to the BDU uniform ($t = 2.286$, $p < .05$). Also, while wearing BDU gear, subjects showed a significant increase in anxiety between each day (one through four) and day five ($t = 2.454$, $p < .05$; $t = 3.513$, $p < .01$; $t = 2.165$, $p < .05$; $t = 3.416$, $p < .01$). It is important to note that wearing MOPP4 on day five of the BDU

condition resulted in an increase in state anxiety, which was very close in magnitude to that seen when MOPP4 was worn the first time on day one of the MOPP4 condition.

Sixteen Personality Factor Questionnaire

Materials

The Sixteen Personality Factor Questionnaire (16 PF) was used to measure personality variables. The test consists of 187 questions related to 16 independent personality factors. There are 10 to 13 questions on each of the 16 factors. The questions are arranged in a cyclical manner so that they are not grouped by factor (see Appendix D).*[30]

Procedure

On the first Thursday of the 10-day test period, subjects completed the 16 PF questionnnaire following administration of the STAI and preceding uniform preparation for those who were scheduled to dress in MOPP4 gear. Subjects were seated at separate desks to allow for privacy. Questionnaires and answer sheets were distributed and subjects were told to read the instructions carefully and then wait for further instructions. The experimenter then briefly reminded the subjects to: "give the first, natural answer as it comes to you, try not to fall back on all middle, uncertain answers, be sure to answer all the questions, and be sure to answer honestly"*[30]. When the whole group completed the questionnaire, those who were scheduled to dress in MOPP4 gear did so. The remaining time was devoted to administration of the state anxiety test and the tasks.

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Results

For each of the 16 factors, a total raw score was calculated and then converted to standard ten (STEN) scores using the norm table for the male college population. The norms for the male college population were chosen because the mean age was almost identical to the sample population. The only factor that was expected to distinguish the sample from the norms was that of intelligence. The STEN scales for each of the factors ranged from 1 to 10, with a mean of 5.5. Student *t* tests were performed on each of the 16 STEN scores, comparing each group mean with the college norm mean of 5.5. As expected, the intelligence factor STEN score (Factor B on Figure 3) for the experimental sample (M = 3.5) differed from the norm STEN score (M = 5.5), (t = -4.79, p = .001). In short, the experimental sample scored significantly lower on the intelligence factor.

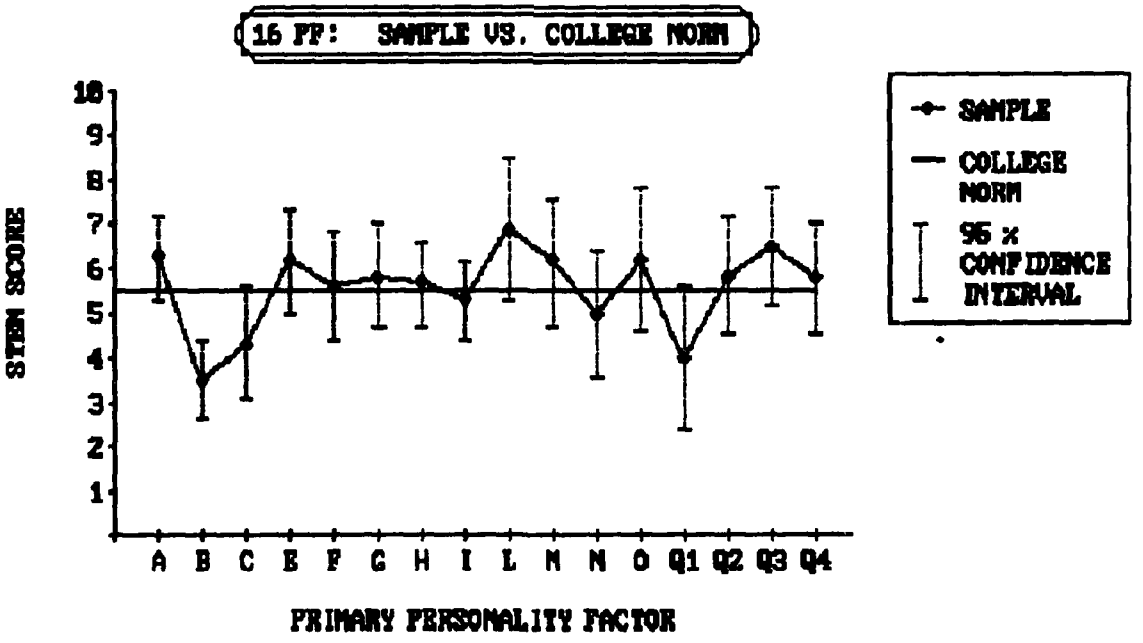

Figure 3. Comparison of sample means with college norms for each of the 16 primary personality factors.

From these 16 primary STEN scores, four second-order factors were computed, (Factor I: low vs. high anxiety, Factor II: introversion vs. extraversion, Factor III: tenderminded emotionality vs. alert poise, and Factor IV: subduedness vs. independence). The second-order factors were computed using various positive and negative weights of the 16 primary factor STEN scores*[30]. Again, the norm mean score for each of these factors is 5.5. Simple student t tests were performed on each of the second-order factors, comparing each group mean to the norm mean of 5.5. No differences were found (see Figure 4).

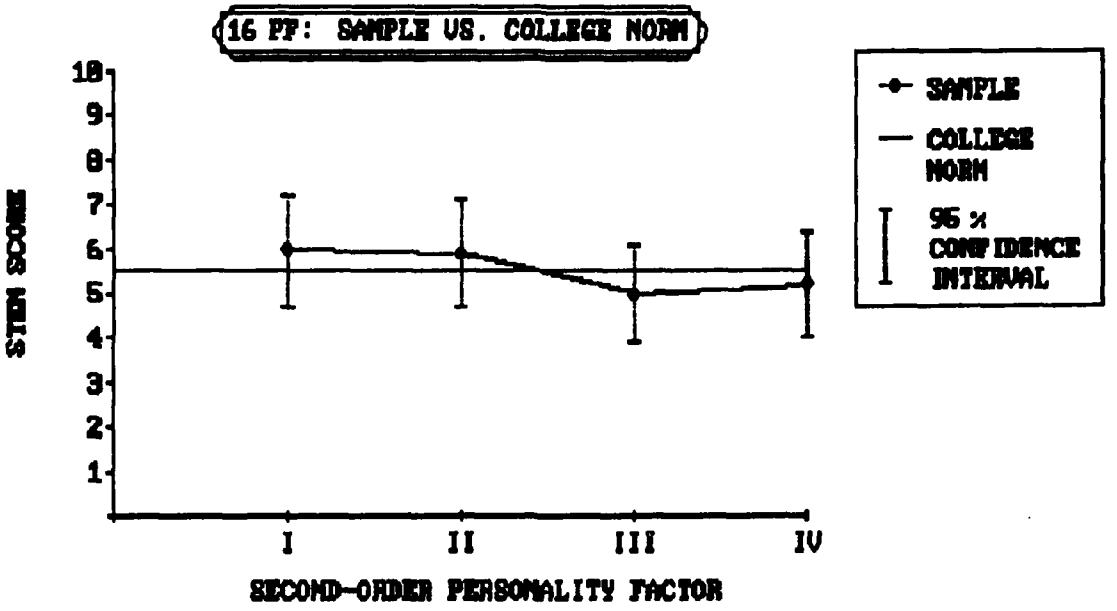

Figure 4. Comparison of sample means with college norms for each of the 4 second-order personality factors.

It is useful to note that the primary factor of intelligence is not used in the computation of any of the four second-order factors. The second-order factors were used for correlational purposes in the remaining analyses.

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Factor I and Factor II were found to be related to the STAI measure of trait anxiety. Factor I: low vs. high anxiety, was found to be positively correlated to trait anxiety, ($r = .706$, $p = .01$). That is, subjects who reported high trait anxiety on the STAI also reported high anxiety on the 16 PF. The same relationship held true for subjects reporting low anxiety (see Figure 5).

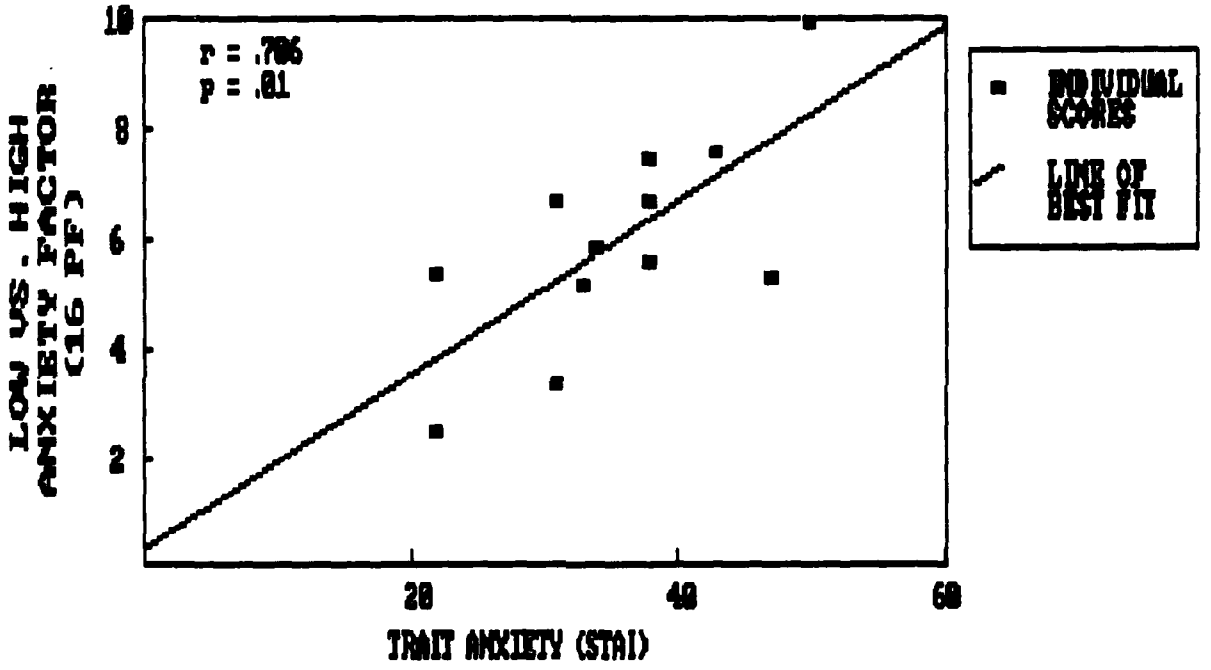


Figure 5. Correlation between low vs. high anxiety factor of the 16 PF and trait anxiety of the STAI.

Factor II: introversion vs. extraversion, was found to be negatively correlated to trait anxiety, ($r = -.865$, $p = .001$). That is, subjects who reported high trait anxiety on the STAI also reported characteristics of introversion and subjects who reported low trait anxiety on the STAI also reported characteristics of extraversion (see Figure 6).

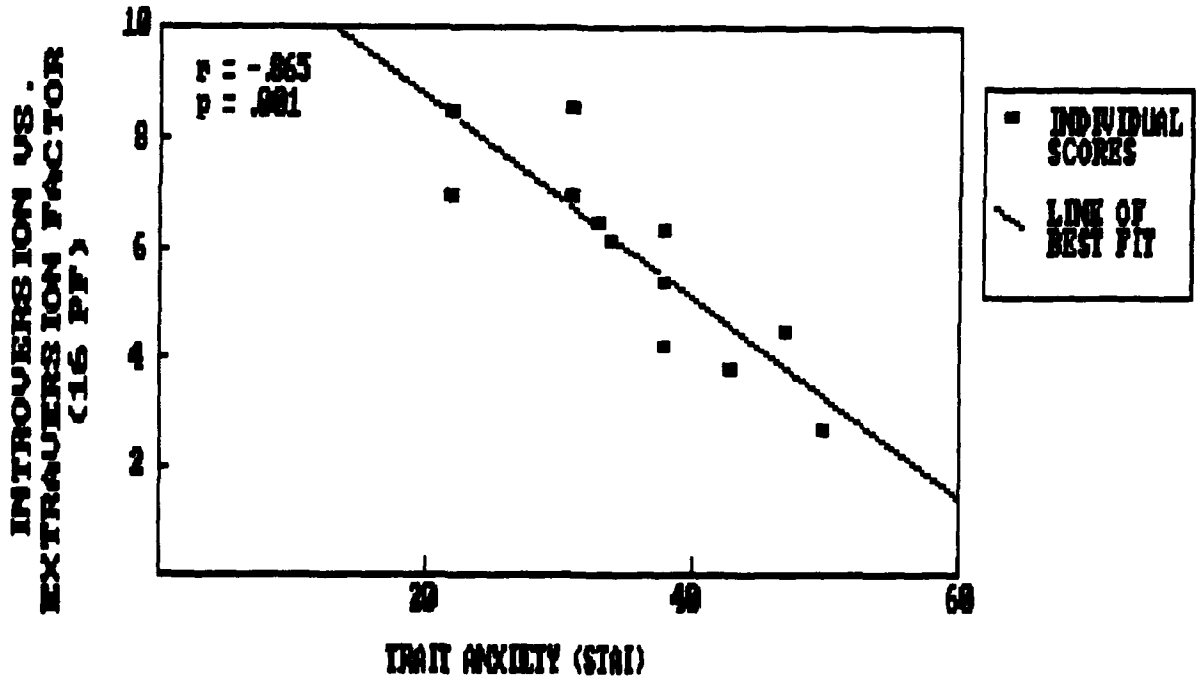


Figure 6. Correlation between introversion vs. extraversion factor of the 16 PF and trait anxiety of the STAI.

The STAI measures of pre- and posttest state anxiety were also found to be related to Factor I and Factor II of the 16 PF. Pre- and posttest scores for state anxiety were averaged across days for the BDU condition (days 1-4) and the MOPP4 condition (days 1-5). Factor I: low vs. high anxiety, was found to be positively correlated to pre- and posttest scores of state anxiety during the BDU condition (BDU pretest: $r = .625$, $p = .040$; BDU posttest: $r = .615$, $p = .044$), but not the MOPP4 condition. While dressed in BDUs, subjects who reported high pre- and posttest state anxiety also reported characteristics of high anxiety (as measured by the 16 PF), while subjects who reported low pre- and posttest state anxiety also reported characteristics of low anxiety (as measured by the 16 PF) (see Figure 7).

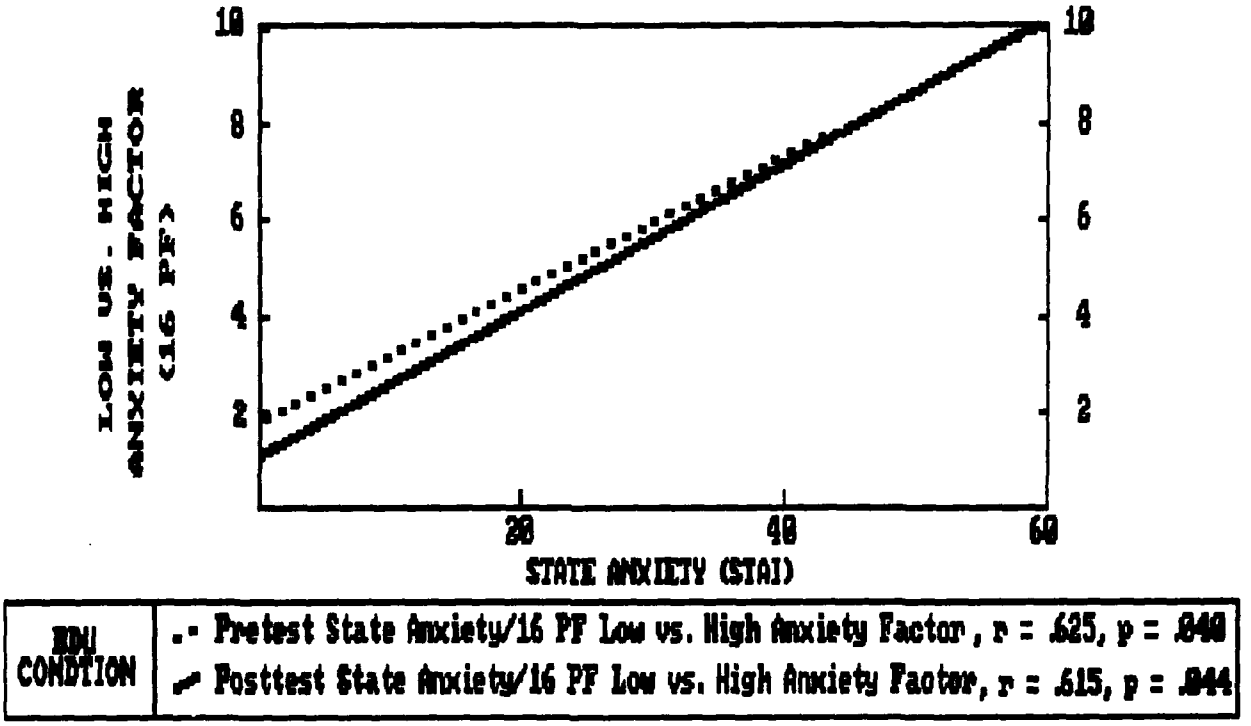


Figure 7. Correlations between the low vs. high anxiety factor of the 16 PF and pre- and poststate anxiety scores of the STAI for the BDU condition.

Scores on Factor II: introversion vs. extraversion, were found to be negatively correlated to pre- and posttest scores of state anxiety during both the BDU condition and the MOPP4 condition (BDU pretest: $r = -.802$, $p = .003$; BDU posttest: $r = -.715$, $p = .013$; MOPP4 pretest: $r = -.682$, $p = .021$; MOPP4 posttest: $r = -.596$, $p = .053$). While wearing BDUs or MOPP4, subjects who reported high state anxiety also reported characteristics of introversion while subjects who reported low state anxiety also reported characteristics of extraversion as measured by the 16 PF (see Figures 8 and 9).

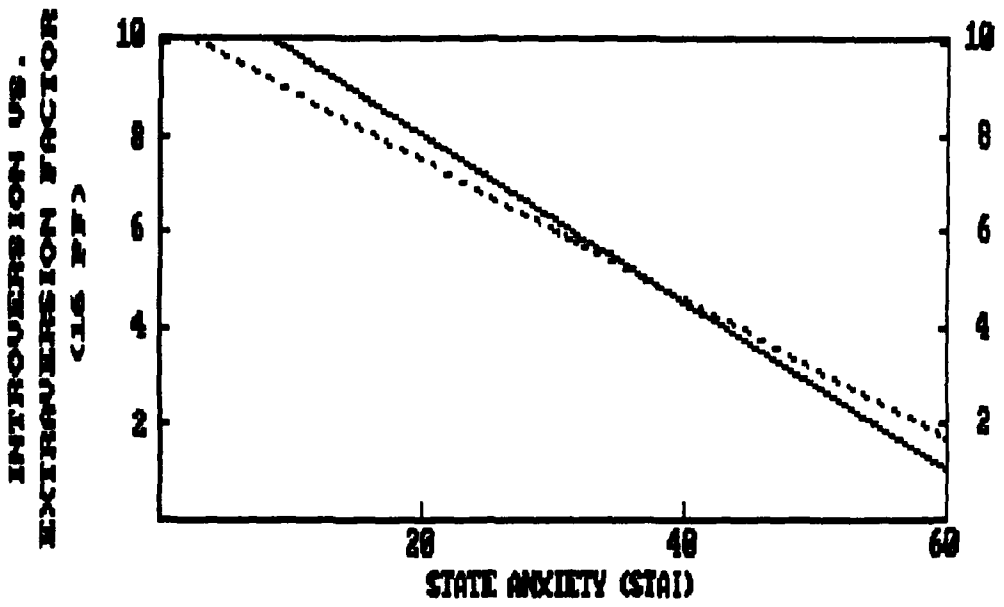


Figure 8. Correlations between the introversion vs. extraversion factor of the 16 PF and pre- and poststate anxiety scores of the STAI for the BDU condition.

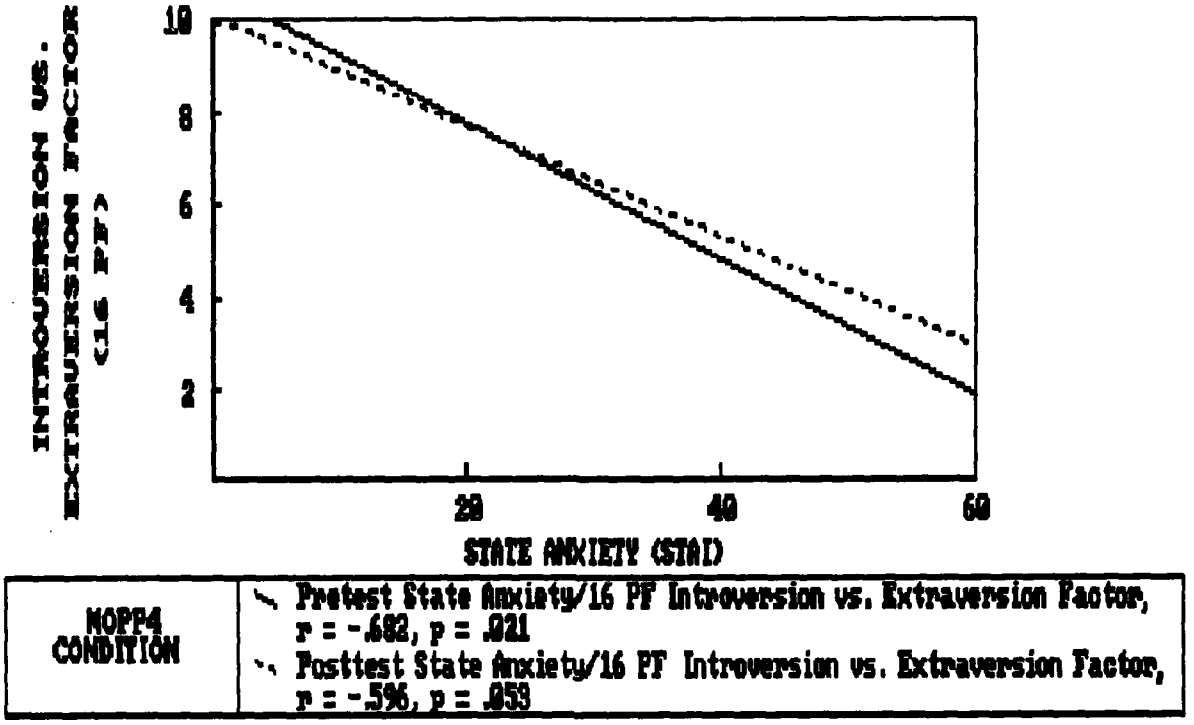


Figure 9. Correlations between the introversion vs. extraversion factor of the 16 PF and pre- and poststate anxiety scores of the STAI for the MOPP4 condition.

Certain secondary factors of the 16 PF were also found to be related to measures of performance. For example, on days two through five during the MOPP4 test period, subjects' performance on the balance beam was related to Factor IV. Factor IV: subduedness vs. independence, was found to be negatively correlated to balance beam speed on the 3.5-inch beam while dressed in MOPP4 gear (day 2: $r = -.629$, $p = .028$; day 3: $r = -.660$, $p = .020$; day 4: $r = -.702$, $p = .011$; day 5: $r = -.604$, $p = .037$). Subjects who were slow on the 3.5-inch beam also reported characteristics of subduedness, and subjects who were fast on the 3.5-inch beam also reported characteristics of independence (see Figure 10). (More detailed method and results sections for the balance beam task will be presented later in the report.)

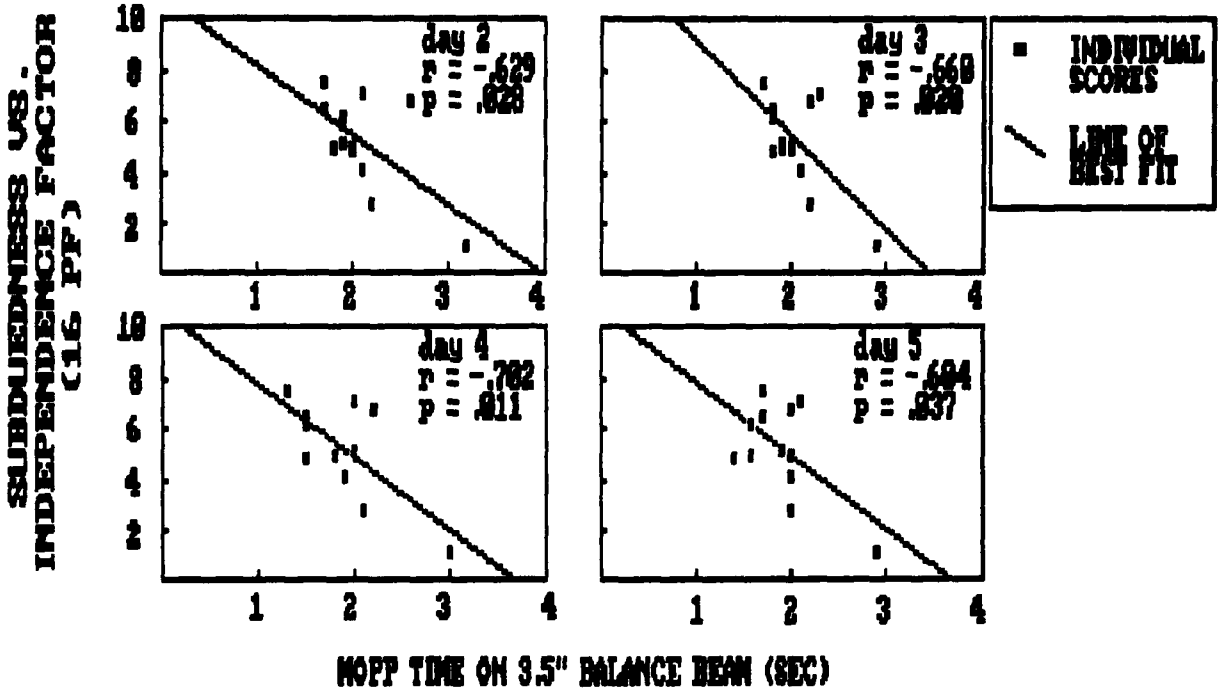


Figure 10. Correlations between the subduedness vs. independence factor of the 16 PF and MOPP4 time on the 3.5-inch balance beam for days 2-5.

Tachistoscope (t-scope) data for both of the stimuli set sizes from day one of the BDU uniform condition were also related to Factor IV (set size 2, $r = .705$, $p = .023$; set size 6, $r = .679$, $p = .031$). Subjects who correctly identified relatively few stimuli also reported characteristics of subduedness. Subjects who correctly identified many of the stimuli also reported characteristics of independence (see Figure 11). (More detailed method and results sections for the t-scope task are presented later in the report.)

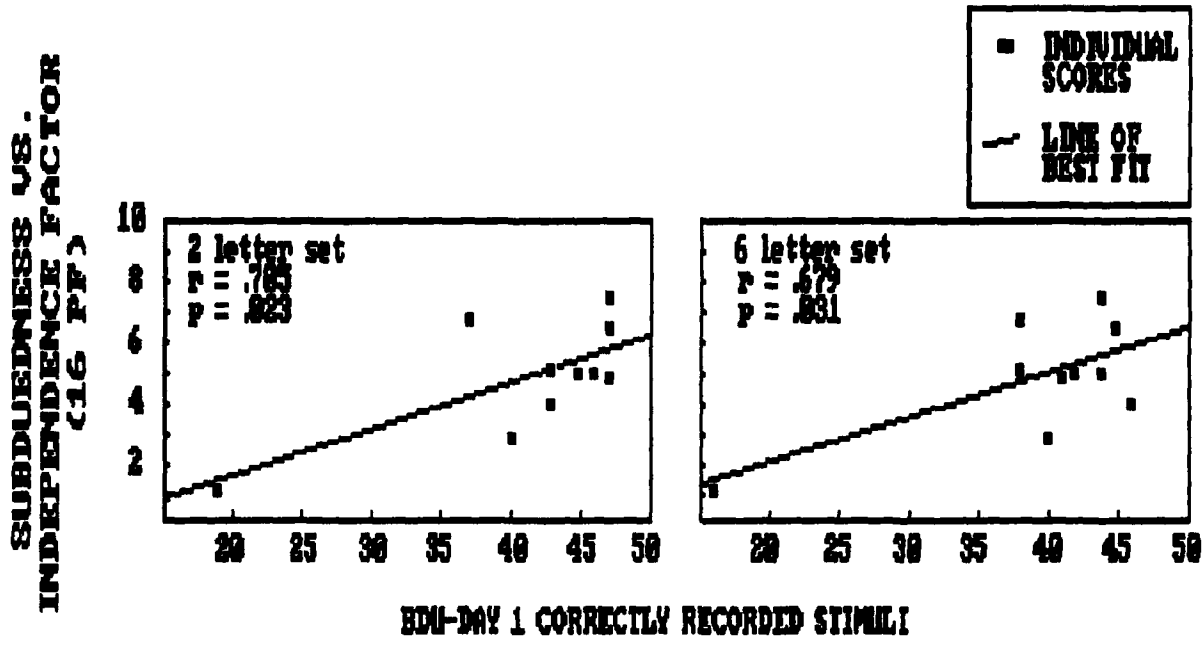


Figure 11. Correlations between the subduedness vs. independence factor of the 16 PF and correctly recorded stimuli on day 1 of the BDU uniform condition for two letter and six letter stimuli sets of the T-scope task.

Balance Beam

Apparatus

Two wooden balance beams were used. Both were 10 feet long and were supported by four 1.5-inch high cross beams. The first beam was 3.5 inches wide, and a total of 3 inches high. The second beam was 1.5 inches wide, and a total of 5 inches high.

Procedure

Subjects were randomly assigned to one of two orders of balance beam participation. Order 1 was the 3.5-inch beam first; order 2 was the 1.5-inch beam first. Subjects were

equally distributed between the two orders. The starting position for a trial consisted of the subject standing at one end of the balance beam with one foot on the floor and one foot on the balance beam. The trial ended when the subject's first foot struck the floor past the end of the balance beam. Any trial on which the subject touched the floor or table for support while negotiating the balance beam was judged an error trial. Subjects were started with the command "Ready...Go", and were timed, using a stopwatch, from the command "Go" until the subject's first foot hit the floor past the end of the balance beam. Subjects were timed on 10 complete trials for each balance beam (trials on which the subject made an error were not timed, but these trials were noted as error trials). Successive trials would begin at opposite ends of the balance beam. The subject continued until 10 trials were completed on each balance beam.

Results

The subjects' mean speed for 10 trials, measured in seconds, was analyzed. Mean scores are presented in Figure 12. Subjects walked the length of the 3.5-inch beam significantly faster than the 1.5-inch beam ($F(1,11) = 25.25$, $p < .001$). They also showed a significant improvement in speed over the days of the experiment. Due to the significance of the Mauchly sphericity test, the degrees of freedom were corrected with the Huynh-Feldt Epsilon (.47552) for the effect of day ($F(1.9,20.9) = 18.18$, $p < .05$). A Newman-Keuls analysis indicated significant increases in speed were found between day one ($M = 2.63$) and each of the other days of the week; day two ($M = 2.35$, $CV(2,44) = .28$, $p < .01$) day three ($M = 2.19$, $CV(3,44) = .32$, $p < .01$), day four ($M = 2.06$, $CV(4,44) = .35$, $p < .01$) and day five ($M = 2.19$, $CV(3,44) = .32$, $p < .01$). This improvement in performance was true for both balance beams and uniform conditions. MOPP4 did not significantly slow the subjects on either beam. Of the four possible interactions, the beam by day interaction was the only

significant one ($F(4,44) = 3.63$, $p = .012$). Individual comparisons of the means revealed that subjects scored faster times on the 3.5-inch beam than on the 1.5-inch beam on each test day regardless of the uniform worn; day one ($t = 4.077$, $p < .01$), day two ($t = 3.654$, $p < .01$), day three ($t = 2.753$, $p < .05$), day four ($t = 2.436$, $p < .05$), and day five ($t = 3.124$, $p < .01$). The comparisons also revealed that subjects scored faster on day five compared to day one on both the 3.5-inch beam ($t = 2.858$, $p < .01$) and the 1.5-inch beam ($t = 4.327$, $p < .01$).

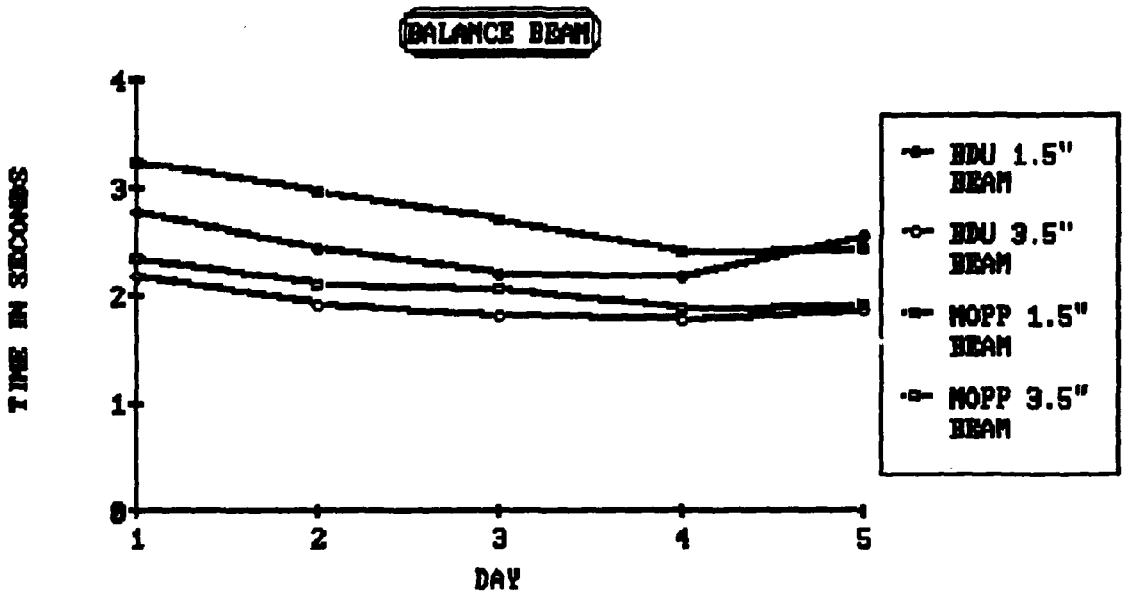


Figure 12. Mean balance beam scores as a function of day.

Vigilance Computer Task

Apparatus

Vigilance was measured using a program developed in our laboratory which ran on pocket computers (Sharp PC-1500A). The dimensions of the computers are 195mm(W) x 25.5mm(H) x 86mm(D) and they weigh 375g each. Each computer has a 26 digit liquid

crystal display of 7 x 156 dots and a full alphanumeric keyboard.

Procedure

During the vigilance task the computer displayed a sequence of digits individually. Each digit was displayed for 200ms with an interdigit interval of 350ms. Subjects were required to detect a sequence of three digits in which the first was an odd, the second was an even, and the third was an odd that was different from the first. Thus, 7-4-5 was a target. Sequences which included odd-even-odd, where the two odds were the same (e.g. 3-4-3), were distractors. Subjects were instructed to indicate that they detected a target by pressing the space bar on the keyboard. Whenever the space bar was pressed during the test, an asterisk (*) appeared on the display. Pressing the space bar when neither a target nor a distractor had occurred was recorded as a bad hit. Test sessions lasted about 10 minutes and included a random number of targets and distractors with an average of 10 of each per session. Because a different number of possible target hits and distractor hits for each session were created during the randomization procedure, subjects' scores were expressed as percentages. Sessions were analyzed on three measures: 1) % target hits, 2) % distractor hits and 3) % bad hits.

Results

Separate analyses were performed for % target hits, % bad hits, and % distractor hits. Mean scores for % target hits are presented in Figure 13. A MANOVA on % target hits indicated that MOPP4 did not significantly affect the average number of targets detected. There was also no significant effect for day nor was there a uniform condition by day interaction.

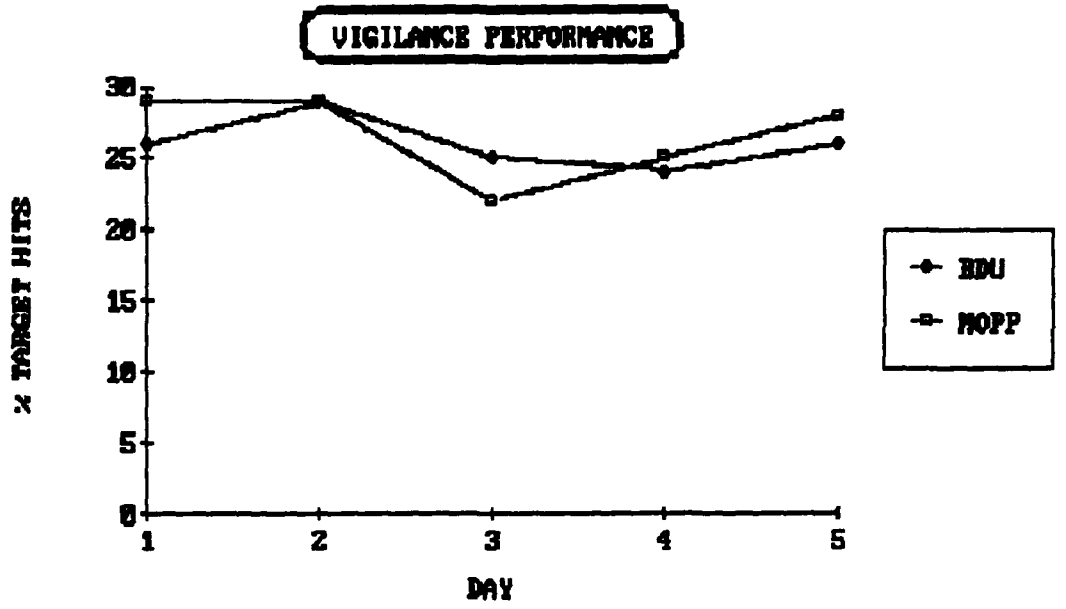


Figure 13. Mean percent target hits as a function of day.

MOPP4 did not affect the % bad hits made by the subjects. However, the % bad hits decreased significantly over successive days in the experiment. Due to the significance of the Mauchly sphericity test, the degrees of freedom were corrected with the Huynh-Feldt Epsilon (.53223) for the effect of day ($F(2.1,23.4) = 3.43$, $p < .05$). A Newman-Keuls analysis revealed that subjects scored a significantly lower percentage of bad hits on day five ($M = .016$) compared to day one ($M = .040$) regardless of uniform condition ($CV(5,44) = .0201$, $p < .05$). The uniform condition by day interaction was not significant (see Figure 14).

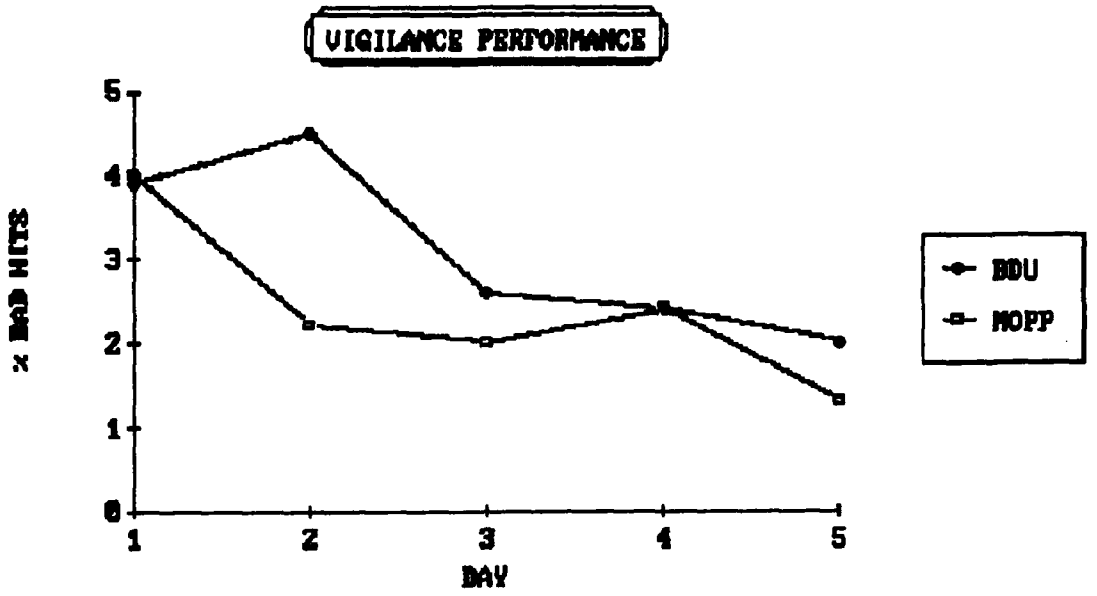


Figure 14. Mean percent bad hits as a function of day.

When wearing MOPP4 the subjects responded to significantly fewer distractors than when they wore only the BDU ($F(1, 11) = 7.72$, $p = .02$). There was no significant effect for day or for the uniform condition by day interaction (see Figure 15).

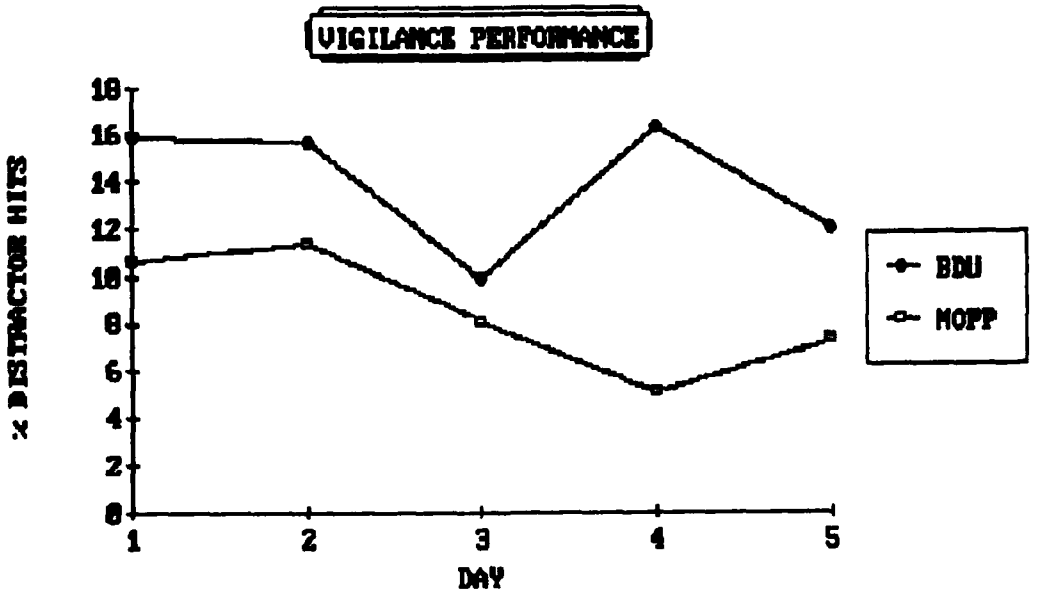


Figure 15. Mean percent distractor hits as a function of day.

Tachistoscope (T-scope)

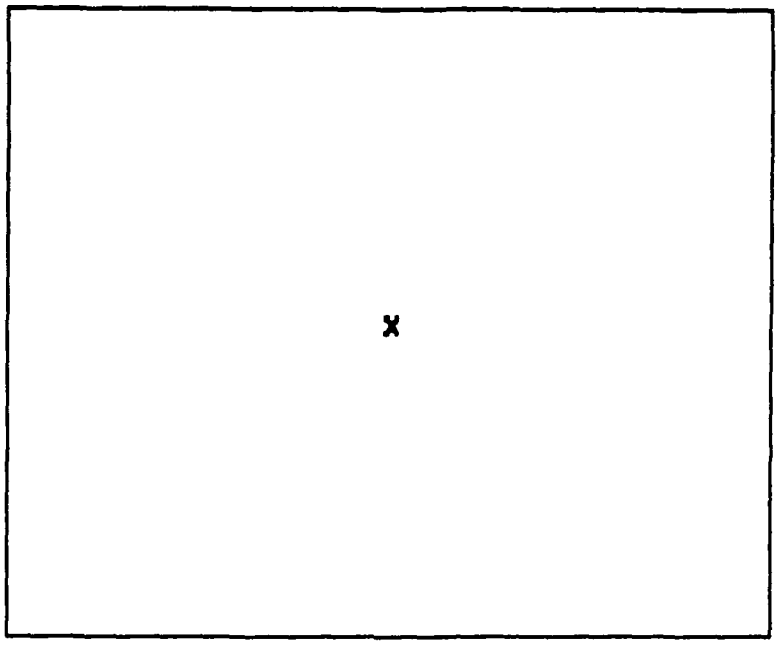
Apparatus and Stimuli

The tachistoscopically presented stimuli consisted of different combinations of letters and lines of different orientations. Each stimulus display had one letter (K, S, C, M, O, or F) printed in the center of the visual field with a line (/, \, -, or |) printed 5 cm horizontally to the left or to the right of the letter (see Figure 16). The letter and the line each subtended approximately a 0.5 degree visual angle. Groups of stimuli consisted of 48 presentations each from two configurations of stimuli. One configuration included different combinations of two letters and four symbols, and one included different combinations of six letters and four symbols. There were three possible two letter sets (K and M; C and S; M and S) and one six letter set (K, S, C, M, O, and F). For each type of stimulus set, the stimuli were presented randomly.

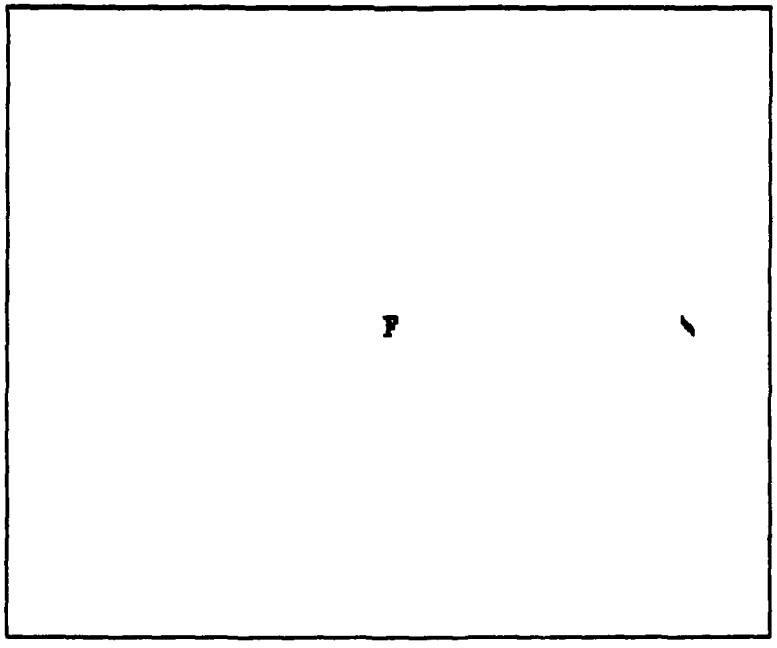
The stimuli were presented on a Stoelting Co. Tachistoscope (Cat. No. 21224). Each stimulus card was presented for 225 ms immediately after the presentation of a 500 ms central fixation cross (see Figure 16). The interstimulus interval was variable, but averaged 15 seconds. The viewing hood was modified for the BDU condition so that a consistent viewing distance of 63.4 cm was maintained.

Procedure

Subjects completed the T-scope task on the first and last day of each uniform condition. On each of the four test days, participants viewed both the two letter set and the six letter set. The presentation of set sizes was randomized so that some subjects received the two letter set first and some received the six letter set first. Also, the assignment of the different combinations of letters and lines that made up the two letter stimuli sets was random. Each subject viewed the same sets of stimuli for all four test days.



Presented for 500 ms



Presented for 225 ms

Figure 16. Example stimuli for the T-scope task.

Instructions were given to the subjects prior to participation. While seated comfortably in front of the tachistoscope, they were told to look into the machine through the viewing hood. Their task was to maintain focus on a fixation cross which would be followed by a letter and line presented simultaneously. After each trial, subjects recorded on an answer sheet the letter and symbol exactly as they saw them. The data from two subjects were not used in this analysis. The data from subject #2 were not used, because he wore glasses when tested in the BDU uniform condition and did not wear lens inserts designed for the MOPP mask when tested in the MOPP4 uniform condition. The data from subject #9 were not used because the speed at which the stimuli were presented was below his perceptual threshold.

Results

The number of stimuli which were correctly recognized and recorded were used in the following analysis. Mean scores for both the 2 and 6 letter stimuli sets are presented in Figure 17. Neither uniform condition, the day of experiment, nor stimuli set size significantly affected performance on the tachistoscope task. Of the four possible interactions, the uniform by day interaction was the only significant one ($F(1,9) = 5.58$, $p = .042$). Individual comparisons however, revealed no differences at $p < .05$.

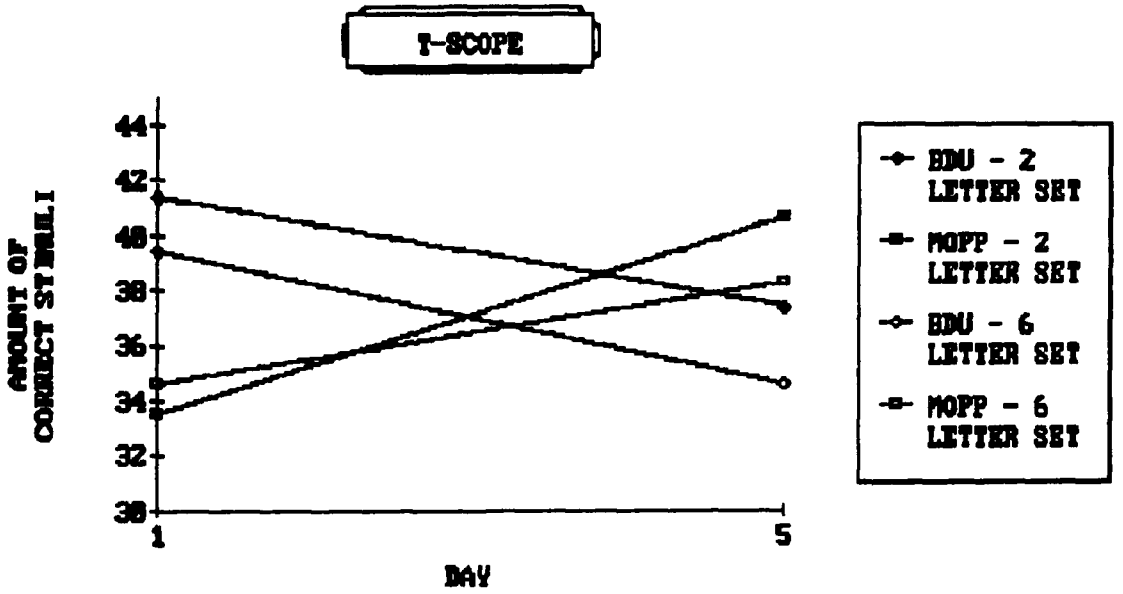


Figure 17. Mean scores for the two letter and six letter stimuli sets as a function of day.

Vision Contrast Sensitivity

Materials and Stimuli

Contrast sensitivity was measured using the VISTECH™ vision contrast test systems (VCTS™), Model 6000 for near vision and Model 6500 for far vision. Each of the VCTS consists of charts with rows of different sine wave gratings presented in decreasing contrast. The five rows each contain different spatial frequencies, which were 1.5, 3, 6, 12 and 18 cycles per degree (visual angle). Charts for the VCTS 6000 measure 5-1/2" x 6-7/8" and were held in place with the VCTS 6000 calibrated holder. Subjects were tested at a distance of 18 inches for the near test. Charts for the VCTS 6500 measure 27" x 37" and were secured on a table top against a wall. Subjects were tested at a distance of 10 feet for the far test.

Procedure

Subjects viewed the near and far vision contrast sensitivity charts under the two uniform conditions. For each viewing condition subjects were tested at five different spatial frequencies. The data from subject #2 was not used because he wore glasses when tested in the BDU uniform condition but did not wear lens inserts designed for the MOPP mask when tested in the MOPP4 uniform condition.

Prior to testing, subjects were given brief verbal instructions as well as detailed written instructions. In short, subjects were instructed that they would be viewing charts and describing the orientation of different sized bars of different contrasts in much the same way that a standard Snellen eye chart is read. Their task was to state the orientation (slanted to the right, slanted to the left, or straight up and down) of the bars which they could see, and to say "blank" if they could not see any bars.

Results

Near and far vision test results were analyzed separately. Mean scores for each test are plotted in Figures 18 and 19. As expected, a significant effect for spatial frequency was obtained for both the near test ($F(4, 40) = 239.64$, $p < .001$) and for the far test ($F(4, 40) = 113.31$, $p < .001$). No effects were found for MOPP4 or for the uniform by spatial frequency interaction for either the near or the far test.

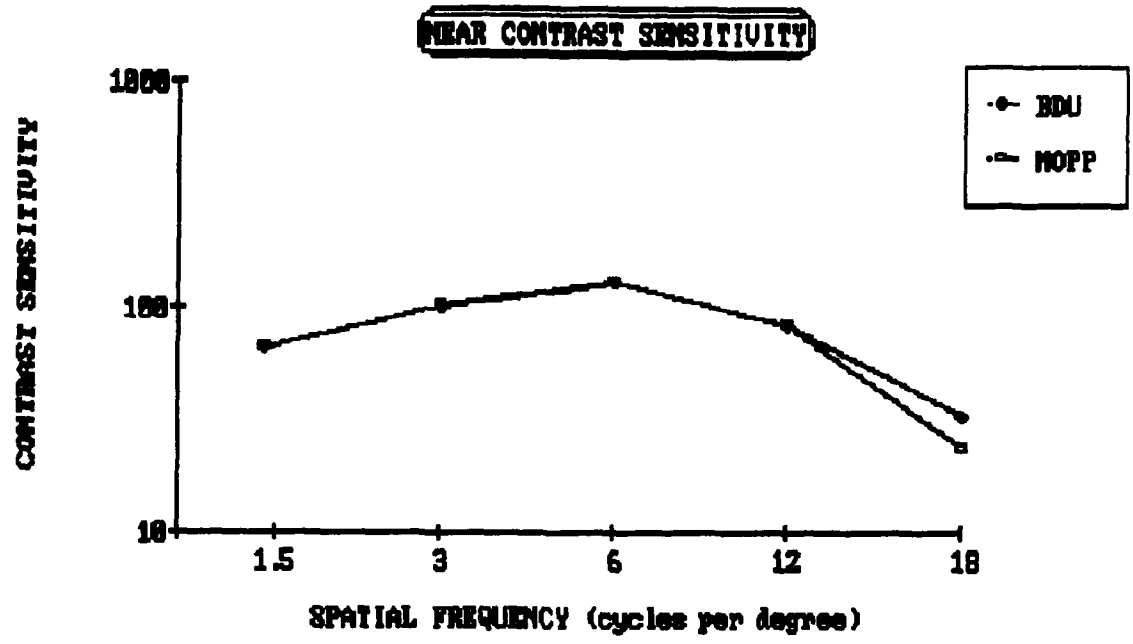


Figure 18. Mean near contrast sensitivity scores as a function of spatial frequency.

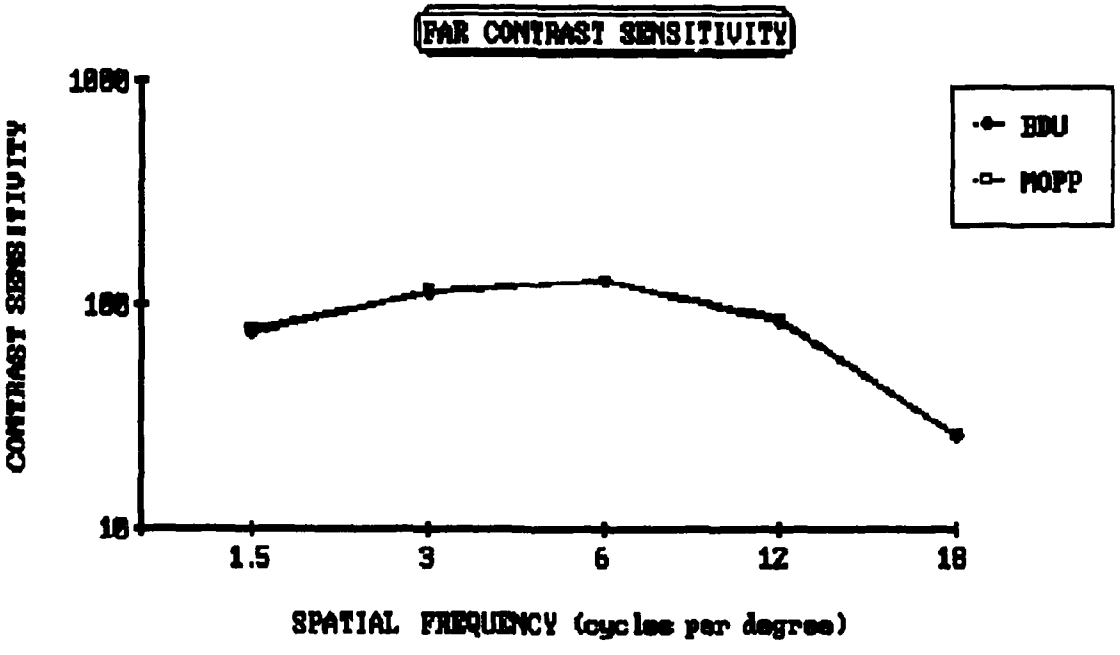


Figure 19. Mean far contrast sensitivity scores as a function of spatial frequency.

Embedded Figures Test

Materials and Stimuli

The embedded figures test (EFT) is a perceptual test in which the extent of competence at perceptual disembedding is measured. In short, perceptual disembedding is the ability to break up an organized visual field separating figure from ground. The perceptual construct measurement of field dependence/independence is a continuous variable where scores reflect the subjects' relative position on that continuum.*[31]

Field dependence is characterized by parts of the field being experienced as fused. People who are field dependent do less well in solving problems that require isolating an essential element from the context in which it is presented. They follow the organization of the field as it is presented. They are global; the organization of the field dictates the manner in which the parts are experienced. Field independence is characterized by the ability to readily separate figure from ground. People who are field independent are likely to impose organization to structures that lack it or may reorganize an organized field. Their perceptions are articulated, that is, their experience is delineated and structured, even when the field lacks structure.*[31]

In the EFT, field dependence/independence is measured by the subject's ability to locate a previously seen simple figure within a larger complex figure. The simple figure is embedded in the complex figure to make it obscure. The test consists of Forms A and B, each having 12 different complex figures. A set of 8 simple figures is used for both Forms A and B.

For the purpose of presentation, each of the complex figures was encased in a plastic page protector and bound together in a loose-leaf notebook. A stylus was used by the subject in order to trace the simple figure when they located it. A stopwatch

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was used to record the time it took each subject to locate the embedded simple figure.

Procedure

Subjects completed the EFT on the second and fourth day of each uniform condition. Form A was administered on day two of each uniform condition and Form B was administered on day four of each uniform condition. Each subject was seated next to the experimenter so that responses could easily be observed. Before administration of the test, subjects were given brief instructions and a practice trial.

> Instructions: "I am going to show you a series of colored designs. Each time I show you one, I want you to describe it in any way you wish. I will then show you a simple form which is contained in that larger design. You will then be given the larger design again, and your job will be to locate the simple form in it. You may ask to see the simple figure as many times as you like" .*[31]

For the practice trial and the 12 test trials, each complex figure was shown for 15 seconds and then covered with the simple figure, which was shown for 10 seconds. The experimenter then turned the simple figure over and removed it to reveal the complex figure. Timing began immediately. As soon as the subject verbalized that he found the simple figure, the time was noted, and the subject traced the simple figure. If the tracing was correct, the noted time was recorded as the solution time for that trial. There was a time limit of 3 minutes or 180 seconds per complex figure. Special timing instructions were followed when subjects gave incorrect responses or asked to review the simple figure.*[31] If no solution was found, the subject scored the full 180 seconds for that trial.

As discussed earlier, there were 12 trials in each Form of the test. Due to procedural error however, only 11 of the 12

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possible trials were administered for Form A of the EFT. Therefore, the mean solution time per trial for each subject, is based on 11 trials for Form A and 12 trials for Form B.

Results

The subjects' mean speed for 11 trials in Form A and 12 trials in Form B, measured in seconds, were analyzed. Mean scores are presented in Figure 20. A MANOVA revealed, as expected with the EFT, a practice effect. Subjects disembedded the simple figures significantly faster on day 4 than on day 2 of the test phase ($F(1, 11) = 7.66$, $p = .018$). Wearing MOPP4 did not affect the speed at which subjects recognized the embedded simple figures, nor was there a significant uniform condition by day interaction.

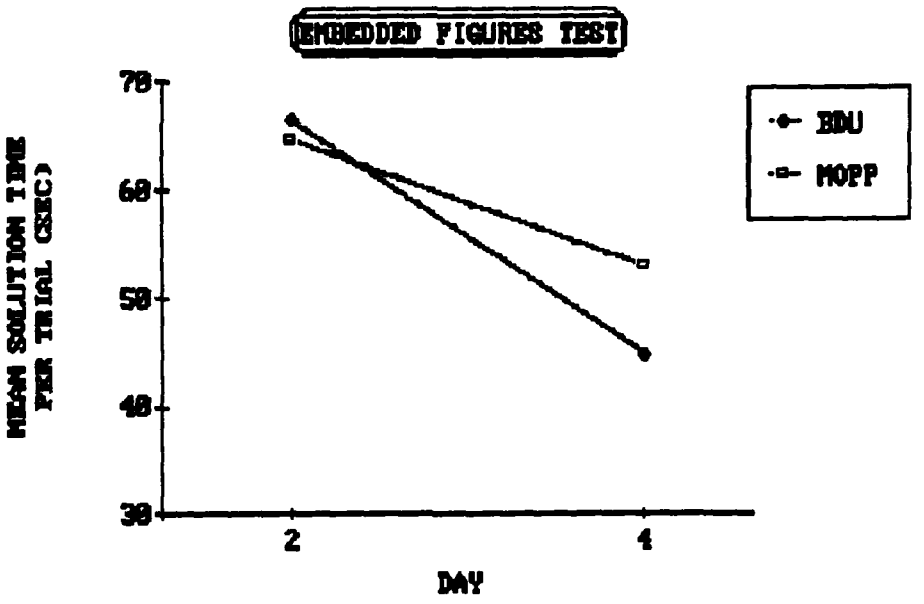

Figure 20. Mean disembedding time as a function of day.

Stroop Color and Word Test

Materials

The subjects were administered the Stroop Color and Word Test*[32], which consists of three parts: Word, Color and Color-Word. Each part was one page long. The 100 items on each page were presented in a matrix consisting of 5 columns and 20 rows. On the Word page, the words "RED", "GREEN", and "BLUE" were printed in black ink and arranged in random order, with the provision that in any column no word was allowed to follow itself. The items on the Color page appeared as "xxxx" and were printed in red, blue, and green ink. The colors were randomized so that no color would follow itself or match the item in the same position on the Word page. The items on the Color-Word page were created by merging the items on the Word and Color pages. The word in the first position on the Word page was printed in the same color ink as the item in the first position of the Color page, producing the first item on the Color-Word page. No color or word followed itself in any column. A GRALAB one hour universal timer (DimCo Gray Co.; Dayton, Ohio) was used to measure the 45 seconds the subjects were given to perform each task.

Procedure

The subjects were tested individually at the beginning and the end of both test weeks wearing either MOPP4 or BDU. All three parts of the test were administered each time. The Word page was administered first. The subjects were instructed to read down the columns out loud and as rapidly as possible, making sure to correct themselves if they made any errors. The words themselves are the names of colors. They continued reading, starting the page over if necessary, until 45s had expired, at which time the experimenter told them to stop. The

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number of words read was recorded and testing continued immediately.

The Color page was the second part of the test. The instructions given were the same as those of the Word page except that the subjects were told to name the color of each "xxxx" representation. After 45s the subjects were told to stop and the number of correctly named colors was recorded.

The Color-Word page was the final part of the test. It was administered in the manner of the previous two tests, except that the subjects were instructed to name the color of the ink each word was printed in, ignoring the word itself. Thus, if the word "RED" typed in blue ink appeared, the correct response would be "blue", for the color of the ink. The experimenter checked the subject's comprehension of the instructions by having him attempt the first two items on the page. When it was evident the directions were clearly understood, the subject performed the task for 45 seconds and the number of items correctly completed was recorded by the experimenter.

Results

Each time the test was administered four scores were taken; one each for Word, Color, and Color-Word, and an interference score which measured the extent to which the printed word interfered with the task of naming the color of the ink in the Color-Word part of the test. The Word, Color, and Color-Word scores were simply counts of the numbers of items completed on the respective test parts. The interference score was calculated by subtracting a predicted Color-Word score from the actual Color-Word score.

$$\text{Interference} = (\text{Color-Word}) - [(\text{Color} \times \text{Word})/(\text{Color} + \text{Word})]$$

The higher the interference score, the less interference of the meaning of the word on color naming.

Mean scores for each measure are presented in Figures 21 to 24. Separate MANOVAs were performed for each measure. Performance on the Word task was not affected by either MOPP4 or by the day of the experiment. Nor was there an interaction between those two variables (see Figure 21).

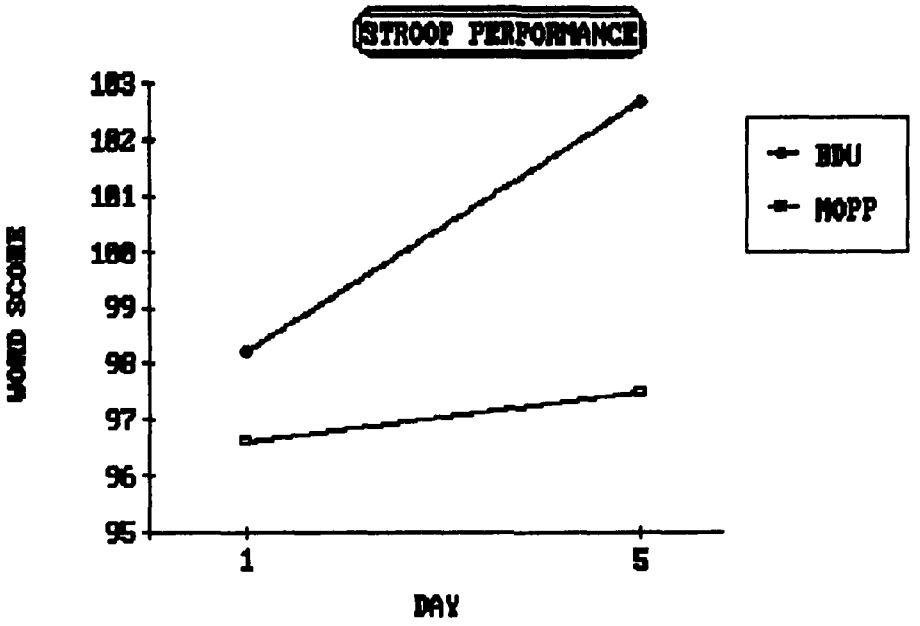

Figure 21. Stroop word score as a function of day.

Performance on the Color task, however, improved over successive days in the experiment ($F(1, 11) = 5.72$, $p = .036$) regardless of the uniform the subjects were wearing. MOPP4 did not affect performance on the Color task, nor was there an interaction between uniform and day of the experiment (see Figure 22).

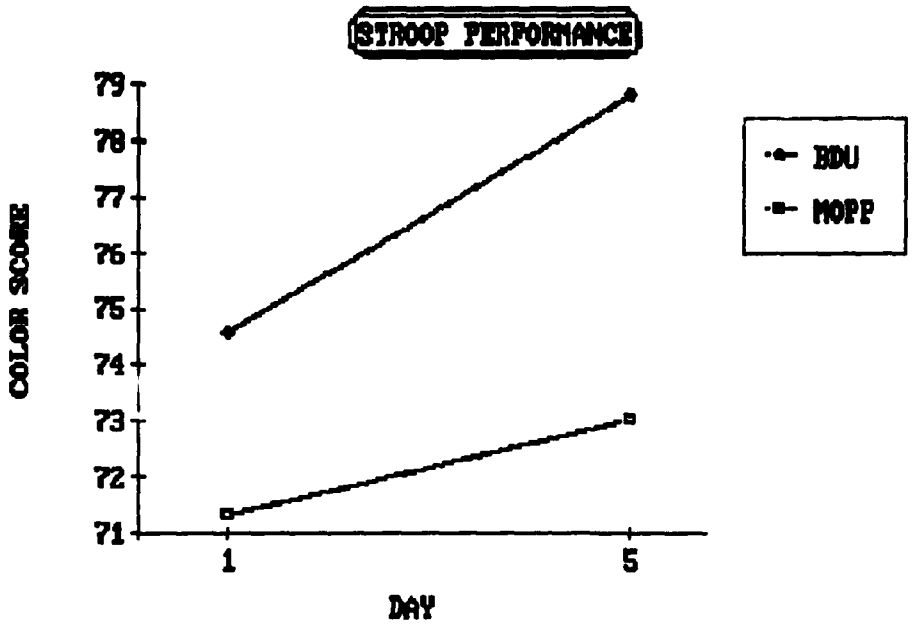

Figure 22. Stroop color score as a function of day.

The third part of the Stroop test (Color-Word) revealed a similar pattern of results. Subjects completed more items on the last day of the test week compared to the first day ($F(1,11) = 20.06$, $p = .001$). As for the other tasks, there was no significant effect of either the uniform or the interaction of the uniform and day of the test (see Figure 23).

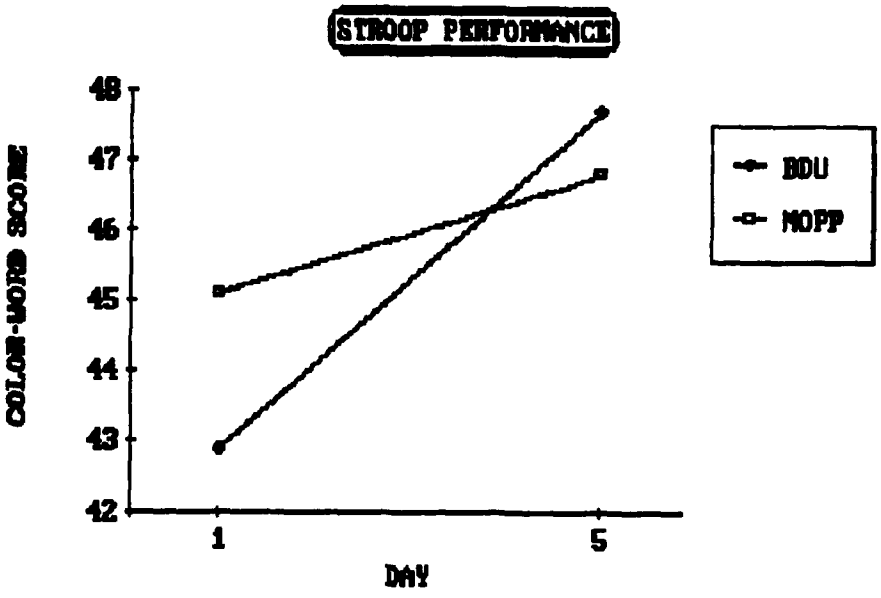

Figure 23. Stroop color-word score as a function of day.

Finally, subjects exhibited significantly less interference on the last day of the test than on the first day ($F(1,11) = 5.54$, $p = .038$). There was no effect of either uniform or the interaction of uniform condition by day of the test (see Figure 24).

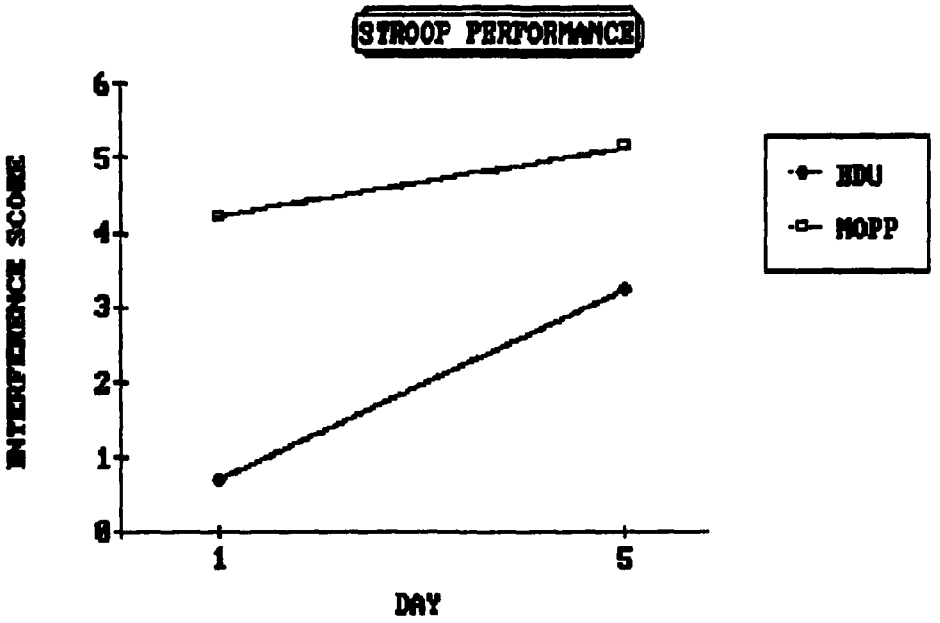

Figure 24. Stroop interference score as a function of day.

DISCUSSION

The severe heat stress produced by microencapsulation has received the greatest attention by researchers. As a result, a great deal is known about the consequences of heat stress in this situation. However, relatively little is known about the psychological effects of microencapsulation in the Army's chemical protective clothing. The U.S. Army's Mission Oriented Protective Posture (MOPP) provides lifesaving protection for the soldier in a toxic environment. However, that protection is accompanied by actual and potential adverse effects, which could reduce a soldier's ability to carry out his mission and jeopardize his life. Our purpose in this research was to identify adverse psychological effects of MOPP gear, exclusive of those produced by heat stress, and to define ways to reduce the impact of these effects.

We took a broad approach to identify areas we believed had significant potential for revealing relationships among psychological variables and parameters of encapsulation. Specifically, we studied the effects of MOPP gear on anxiety because we had seen previously that, under some conditions, merely donning MOPP gear increased anxiety. Measurements of personality factors were included in the hopes of identifying variables that would allow us to predict which soldiers have a greater resistance to the adverse psychological effects of MOPP gear. Finally, we studied cognitive and psychomotor performances with the expectation that there also would be significant adverse effects of MOPP gear on these types of measures.

Anxiety

The primary focus of the present research was on the anxiogenic effects of wearing the Army's chemical protective clothing ensemble, MOPP4. Several specific effects of microencapsulation in MOPP gear have been demonstrated

previously. For example, Brooks, Xenakis, Ebner, and Balson[15] reported that 14 of 70 military subjects required intervention by the experimenter to psychological reactions from wearing MOPP gear in a simulated battlefield environment. Chief among the reactions was the debilitating anxiety diagnosed in 11 of the 14 subjects. More recently, Carter and Cammermeyer[16,17] found consistent biopsychological responses to wearing chemical protective clothing. These effects included anxiety, difficulty breathing, visual impairment, deficits in concentration, and excessive fatigue.

In prior studies, we found that merely donning MOPP gear increased the reported level of anxiety.[20] The present study confirmed and extended those findings. We report here that the first day our subjects put on the complete MOPP gear (MOPP4), whether it was on day one or day five of the experiment, they showed a significant increase in state anxiety. Further, we observed that the level of anxiety of subjects while wearing MOPP4 decreased over the course of the five days, so that by the fifth day of wearing MOPP4 for 2h per day, they no longer showed elevated anxiety. This latter finding is important because it reveals the potential for acclimating soldiers to the variety of debilitating effects of microencapsulation. Remaining questions in regard to acclimatization are: "Can soldiers successfully acclimate to other effects of microencapsulation?" and "What are the optimum conditions for achieving acclimatization to the effects of microencapsulation?"

Personality

It has been noted by us, and by others,[11,13,14,33] that not all subjects respond to MOPP gear with the same intensity of reaction, and, that their responses may be associated with personality factors. We observed, in the present research, that subjects who reported high levels of anxiety before or after the daily test period, tended to show traits associated with

introversion on the 16PF. In contrast, subjects who were less anxious showed more traits associated with extraversion.

This relationship between two personality characteristics is interesting and may be valuable in defining a personality profile that is associated with high performance soldiers. It has been more difficult to demonstrate correlations between personality variables and differences in performance. However, we found two correlations of particular interest. First, we observed a consistent relationship between the subduedness vs. independence personality factor and performance on the 3.5-inch balance beam. In general, soldiers who performed better on the 3.5-inch balance beam tended to be more independent. Similar results were not found for the narrower 1.5-inch balance beam, probably because the subjects were not able to quickly walk across it without falling; i.e., it was too narrow. The factor of independence was also positively related to correct identification of visual stimuli in the tachistoscope task. These latter findings were not observed under all conditions tested, but they were evident frequently enough to support the expectation that future research will further define the relationship between personality factors and cognitive or psychomotor performances.

These findings are especially interesting because they support the hypothesis that personality measures will be useful in predicting how soldiers will respond to microencapsulation generally, and to wearing MOPP gear in particular. Two directions for future investigation should be followed. First, what are the best personality measures for predicting the effects of microencapsulation? Second, what specific responses to microencapsulation are predictable? In particular, to what extent can we predict degradations in performances related to military tasks?

Performance Measures

While uniform had a significant effect on anxiety, it appeared to have little effect on the various performance measures used. For the vigilance task, for example, uniform had no effect except for one parameter. Surprisingly, when soldiers were in MOPP4 they responded to fewer distractors than when they were in the BDU. Thus, they actually performed better when they were encapsulated. This unexpected finding is difficult to explain, but forces us to reconsider whether all performance effects of encapsulation are deleterious.

Wearing MOPP4 had no measureable effects on the performance of soldiers on the *five remaining performance* tests; balance beam, Stroop color and word, embedded figures, vision contrast sensitivity, and the tachistoscope. There were significant practice effects for the balance beam, the Stroop color and word, and the embedded figures tests. The spatial frequency effects seen in the contrast sensitivity test simply validate that the test was conducted properly, but do not reveal anything about the effects of encapsulation. Finally, in retrospect, we believe that the lack of effect of MOPP4 on performance on the tachistoscope may be due to the way the test was configured. In subsequent tachistoscope tests a wider range of difficulty of conditions may reveal the effects of uniform on performance.

Researcher's Dilemma

This research was carried out with the expectation that there would be significant effects of MOPP4 on the various performance measures assessed. The fact that we found so few significant effects of the uniform condition deserves comment. There are three possible explanations for the paucity of significant effects. First, it is possible that we chose performance measures that are not sensitive enough to detect the deficits that are present. Second, there are no performance deficits in the domains we assessed, beyond those imposed by heat stress. Third, there are deficits, but they don't occur

until soldiers have been encapsulated for a longer period of time than was tested under the protocol for this experiment.

Herein lies a researcher's dilemma. We have reason to believe that encapsulation in MOPP4 does have adverse effects on a soldier's performance, including cognitive performance, when he is in MOPP4 for a long enough period of time or in a combat situation. However, due to the reasonable and ethical constraints imposed by policies for experimentation using human subjects, we are prohibited from putting soldiers in situations that might have serious or long-term negative effects, especially psychological effects. Therefore, we cannot expose them to extended battlefield-like situations to determine if their performance is degraded more when combat is combined with MOPP4, than when they are in combat without wearing MOPP4. Future research must define new ways to reveal the degrading effects of microencapsulation without jeopardizing the psychological or physical health of human subjects.

In conclusion, the Army designs chemical protective equipment that protects a soldier effectively in a toxic environment. The very equipment that saves lives also creates burdens of heat stress, restricted sensory input, problems in communication, and, to some extent, deficits in emotional and cognitive performance. In the research described here, we sought to identify specific adverse psychological effects of microencapsulation, and to define ways to reduce the impact of these effects on soldier performance. It must be assumed that some foreign countries who would use chemical or biological weapons against us have faced the same problems we have addressed here. By continuing to seek solutions to the problems associated with the use of chemical protective equipment, we can achieve an important advantage over potential adversaries.

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APPENDICES

A. Description of Mission Oriented Protective Posture (MOPP).

B. Subject Comparison Survey and MOPP Experience and Athletic Survey.

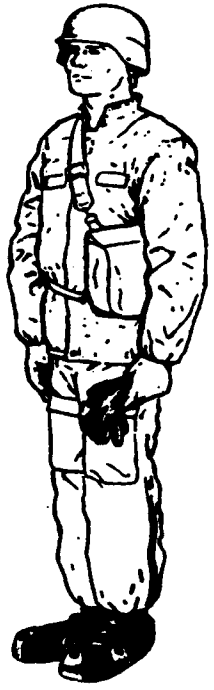
C. Volunteer Agreement of Informed Consent.

D. Sixteen Personality Factor Questionnaire: More Details.

APPENDIX A.

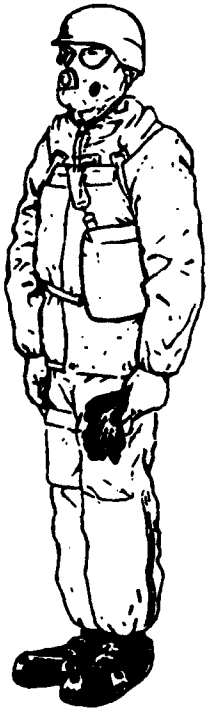
Description of Mission Oriented Protective Posture (MOPP).

MOPP LEVEL 1	
OVERGARMENT	Worn*
OVERBOOTS	Carried
MASK/HOOD	Carried
GLOVES	Carried

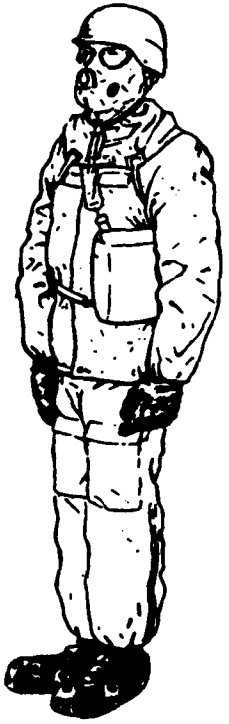


MOPP LEVEL 2	
OVERGARMENT	Worn*
OVERBOOTS	Worn
MASK/HOOD	Carried
GLOVES	Carried

*Overgarment worn open or closed based upon the temperature.



MOPP LEVEL 3	
OVERGARMENT	Worn
OVERBOOTS	Worn
MASK/HOOD	Worn*
GLOVES	Carried



MOPP LEVEL 4	
OVERGARMENT	Worn
OVERBOOTS	Worn
MASK/HOOD	Worn
GLOVES	Worn

*Overgarment and hood worn open or closed based upon the temperature.

APPENDIX B.

Subject Comparison Survey

and MOPP Experience and Athletic Survey.

Subject Comparison Survey

This survey is designed to help the experimenter make various comparisons among test subjects. The survey is confidential and you may omit any questions you feel uncomfortable answering. However, we would appreciate your cooperation and honesty. Thank you.

Please fill in the appropriate answers on the line provided:

Age _____
Height _____ ft. _____ in.
Weight _____ lbs.
What U. S. state were you born in? _____
In what U. S. state have you spent the last five years? _____

Please check the most appropriate answers to the following questions.

Which ethnic group do you belong to?
white ( ) black ( ) hispanic ( ) other ( )

What religion do you consider yourself?
Protestant ( ) Catholic ( ) Jewish ( ) other ( )
no preference ( )

Do you wear eyeglasses? yes ( ) no ( )

Do you wear contact lenses? yes ( ) no ( )

To your knowledge are you color blind? yes ( ) no ( )

Do you drink alcohol? yes ( ) no ( )

If you do drink alcohol, what type of alcohol do you most often drink?
beer ( ) wine ( ) hard liquor ( )

Approximately how much alcohol do you drink in an average week? Please answer by giving the average number of glasses or shots of alcohol per week. _____

Did you drink any alcohol last night? yes ( ) no ( )

Are you, or have you ever been a user of marijuana?
yes ( ) no ( )

If you use marijuana, approximately how many times a week, on the average, do you smoke marijuana? _____

Do you smoke cigarettes? yes ( ) no ( )

If so, approximately how many cigarettes per day do you smoke?

less than 1 pack ( )
about 1 pack ( )
about 2 packs ( )
more than 2 packs ( )

Do you usually drink any coffee during an average week?
yes ( ) no ( )

If yes, approximately how much coffee do you drink?

6 or more cups a day ( )
4 or 5 cups a day ( )
3 cups a day ( )
2 cups a day ( )
1 cup a day ( )
3 to 4 cups a week ( )
1 or 2 cups a week ( )

Have you had any coffee today? yes ( ) no ( )

Approximately how many hours of sleep do you receive a night (on an average night)?

less than 5 hours ( )
6 or 7 hours ( )
8 or 9 hours ( )
over 9 hours ( )

How many hours of sleep did you receive <u>last night</u>?

less than 5 hours ( )
6 or 7 hours ( )
8 or 9 hours ( )
over 9 hours ( )

On most days, how many meals a day do you eat?

over 3 meals ( )
3 meals ( )
2 meals ( )
1 meal ( )

Do you usually have a snack during the day? yes ( ) no ( )

How many meals have you had so far today?

over 3 meals ( )
3 meals ( )
2 meals ( )
1 meal ( )
none ( )

Are you involved in a regular exercise program? yes ( ) no ( )

If so, approximately how many hours a week do you exercise?

over 7 hours/wk ( )
5 to 6 hours/wk ( )
4 hours/wk ( )
3 hours/wk ( )
1 or 2 hours/wk ( )
less than 1 hour/wk ( )

What is your marital status?

single ( )
married ( )
separated ( )
divorced ( )
widowed ( )

Do you have any children? yes ( ) no ( )

If so, how many children do you have? _____

Some people may have different views on how comfortable they are in answering some of the questions in this survey. Next to the following categories please mark how you feel most people would feel about answering the questions in this survey regarding each category.

marital status:
very uneasy ( ) moderately uneasy ( )
slightly uneasy ( ) not at all uneasy ( )

drinking alcohol:
very uneasy ( ) moderately uneasy ( )
slightly uneasy ( ) not at all uneasy ( )

smoking marijuana:
very uneasy ( ) moderately uneasy ( )
slightly uneasy ( ) not at all uneasy ( )

exercise program:
very uneasy ( ) moderately uneasy ( )
slightly uneasy ( ) not at all uneasy ( )

MOPP EXPERIENCE AND ATHLETIC SURVEY

1. How many times have you worn MOPP gear?

2. How much total training time have you had in MOPP gear?

   Level 2 ?_____

   Level 3 ?_____

   Level 4 ?_____

3. How much time have you spent in MOPP gear in the past six months?

4. How much time have you spent in MOPP gear in the past month?

5. What kind of sports do you participate in?

   How often? How many hours a week?

6. How would you rank your level of physical activity?

   Not at all active _____
   Somewhat active _____
   Moderately active _____
   Very active _____

APPENDIX C.

Volunteer Agreement of Informed Consent.

VOLUNTEER AGREEMENT AFFIDAVIT

For use of this form, see AR 40-38; the proponent agency is the Office of the Surgeon General

THIS FORM IS AFFECTED BY THE PRIVACY ACT OF 1974

1. **AUTHORITY:** 10 USC 3012, 44 USC 3101 and 10 USC 1071-1087.

2. **PRINCIPAL PURPOSE:** To document voluntary participation in the Clinical Investigation and Research Program. SSN and home address will be used for identification and locating purpose.

3. **ROUTINE USES:** The SSN and home address will be used for identification and locating purposes. Information derived from the study will be used to document the study; implementation of medical programs; teaching; adjudication of claims; and for the mandatory reporting of medical condition as required by law. Information may be furnished to Federal, State and local agencies.

4. **MANDATORY OR VOLUNTARY DISCLOSURE:** The furnishing of SSN and home address is mandatory and necessary to provide identification and to contact you if future information indicates that your health may be adversely affected. Failure to provide the information may preclude your voluntary participation in this investigational study.

PART A - VOLUNTEER AFFIDAVIT

VOLUNTEER SUBJECTS IN APPROVED DEPARTMENT OF THE ARMY RESEARCH STUDIES

Volunteers under the provisions of AR 70-25 are authorized all necessary medical care for injury or disease which is the proximate result of their participation in such studies.

I, _____ SSN _____ having
(last, first, middle)

full capacity to consent and having attained my _____ birthday, do hereby volunteer to participate in

_____
(research study)

under direction of _____ conducted at _____
(name of institution)

The implications of my voluntary participation; the nature, duration and purpose of the research study; the methods and means by which it is to be conducted; and the inconveniences and hazards that may reasonably be expected have been explained to me by

_____

I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights on study-related injury I may contact

_____

at _____
(name and address of hospital & phone number (include area code))

I understand that I may at any time during the course of this study revoke my consent and withdraw from the study without further penalty or loss of benefits however, I may be ☐ required *(military volunteer)* or ☐ requested *(civilian volunteer)* to undergo certain examination if, in the opinion of the attending physician, such examinations are necessary for my health and well-being. My refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled.

PART B - TO BE COMPLETED BY INVESTIGATOR

INSTRUCTIONS FOR ELEMENTS OF INFORMED CONSENT:(Provide a detailed explanation in accordance with Appendix E, AR 40-38 or AR 70-25.)

DESCRIPTION OF STUDY

The Army continues to be interested in improving the comfort and performance of soldiers while dressed in MOPP gear. The purpose of this study is to measure several aspects of your performance in both MOPP gear and BDU. Performance will be assessed using several paper and pencil tasks, two vision tasks, a computer task, and a walking task. Although there is no direct benefit to you, the results of this study will help determine the direction of any improvements that might be made in the MOPP gear.

(CONTINUE ON REVERSE)

DA FORM 5303-R, APR 84

PART B - TO BE COMPLETED BY INVESTIGATOR *(cont'd)*

You will be one of 10 military volunteers who will participate in 10 sessions of approximately 3 hours duration. There will be 5 sessions on successive days followed by 5 sessions on successive days a minimum of one week later. For 6 of the sessions you will be wearing MOPP gear. These sessions will be conducted in a comfortable air-conditioned laboratory in the Development building at the US Army Research, Development, and Engineering Laboratory in Natick, Massachusetts. For most of the time, you will be seated comfortably in the lab working on paper and pencil tasks, playing a game on a hand held computer, or filling out surveys related to your comfort. Your vision will be assessed using two tasks. In one task you will be asked to identify patterns presented at a distance and near by. In a second task, you will be required to identify rapidly presented symbols. Additionally, you will be asked to walk on a secured 2 x 4, no more than four inches off the ground, to assess your balance control. For the sessions conducted in MOPP gear, you will be given a rest period every hour, during which time you will be able to remove your headgear and take care of hydration and elimination needs.

Health and Safety Risks. Past experience indicates that boredom will be your biggest concern. Because of the duration of the study and the comfortable ambient temperatures, we do not anticipate any heat stress associated with the wearing of the MOPP gear. However, it is IMPORTANT to remember that you can withdraw from the study at any time you believe it is necessary. Also, any time during the study, if you feel very hot and sweaty, faint or nauseous, or have a headache you should tell one of the investigators who will be immediately available at all times.

All data and medical information obtained about you as an individual will be considered privileged information and held in confidence; you will not be identified in any presentation of the results. However, complete confidentiality cannot be promised, particularly to subjects who are military personnel, because information bearing on your health may be required to be reported to appropriate medical or command authorities, and applicable regulation "notes the possibility that the Food and Drug Administration and U.S. Army Medical Research and Development Command officials may inspect the records".

SIGNATURE OF VOLUNTEER	DATE SIGNED	SIGNATURE OF LEGAL GUARDIAN *(If volunteer is a minor)*
PERMANENT ADDRESS OF VOLUNTEER	TYPED OR PRINTED NAME AND SIGNATURE OF WITNESS	DATE SIGNED

Reverse of DA FORM 5303-R, Apr 84

APPENDIX D.

Description of the Sixteen Personality Factor Questionnaire

Description of the 16 PF Questionnaire

The following is a list of the 16 factors of the Sixteen Personality Questionnaire*[30] with a brief description of each: Factor A, reserved vs. outgoing; Factor B, less intelligent vs. more intelligent; Factor C, affected by feelings vs. emotionally stable; Factor E, humble vs. assertive; Factor F, sober vs. happy-go-lucky; Factor G, expedient vs. conscientious; Factor H, shy vs. venturesome; Factor I, tough-minded vs. tender-minded; Factor L, trusting vs. suspicious; Factor M, practical vs imaginative; Factor N, forthright vs. shrewd; Factor O, placid vs. apprehensive; Factor Q_1, conservative vs. experimenting; Factor Q_2, group-dependent vs. self-sufficient; Factor Q_3, undisciplined self-conflict vs. controlled; and Factor Q_4, relaxed vs. tense.

There are 10 to 13 questions on each of the 16 factors. The questions are arranged in a cyclical manner so that they are not grouped by factor. For all of the factors except intelligence, there are three possible responses to each question; the first and the last are bipolar choices whereas the second choice is a "middle of the road" or "uncertain" type of response. For these types of questions, it is possible to score 0, 1, or 2. The intelligence factor differs in that there are three possible responses: one is right and two are wrong. For these types of questions, it is possible to score 0 for a wrong response and 1 for a correct response. The questionnaire takes a minimum of 45 minutes to complete with no time limit.

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